Motorship

TRADE MARK REGISTERED

New York Seattle San Francisco

Volume XI No. 8 AUGUST 1926 Price 35 Cents

ARTICLES on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

ILLUSTRATIONS of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

Reg. U. S. Pat. Office and abroad

Vol. XI | August, 1926 | No. 8

New York Central's First Diesel Tug

Geared Diesel Towboat No. 21, Converted from Steam, Clutch-operated, and Pilot House Controlled, Now Placed in Service

EQUIPPED with a 6 cylinder, 300 hp. Winton Diesel driving a 7 ft. 8 in. diameter wheel through Falk reduction gearing and Bibby couplings, with a special system of pilot house control by friction clutches, New York Central Railroads's first Diesel towboat, No. 21, has recently gone on service and is now actively employed in working car-floats from the company's various terminals. New York Central has been among the foremost of large towboat owners to realize the advantages accruing from the fitting of Diesel engines to these vessels and No. 21—a conversion from steam—marks a step forward in an extensive Dieselization programme which the marine department, under Mr. W. B. Pollock, now has under way.

Characteristics of N. Y. C. No. 21

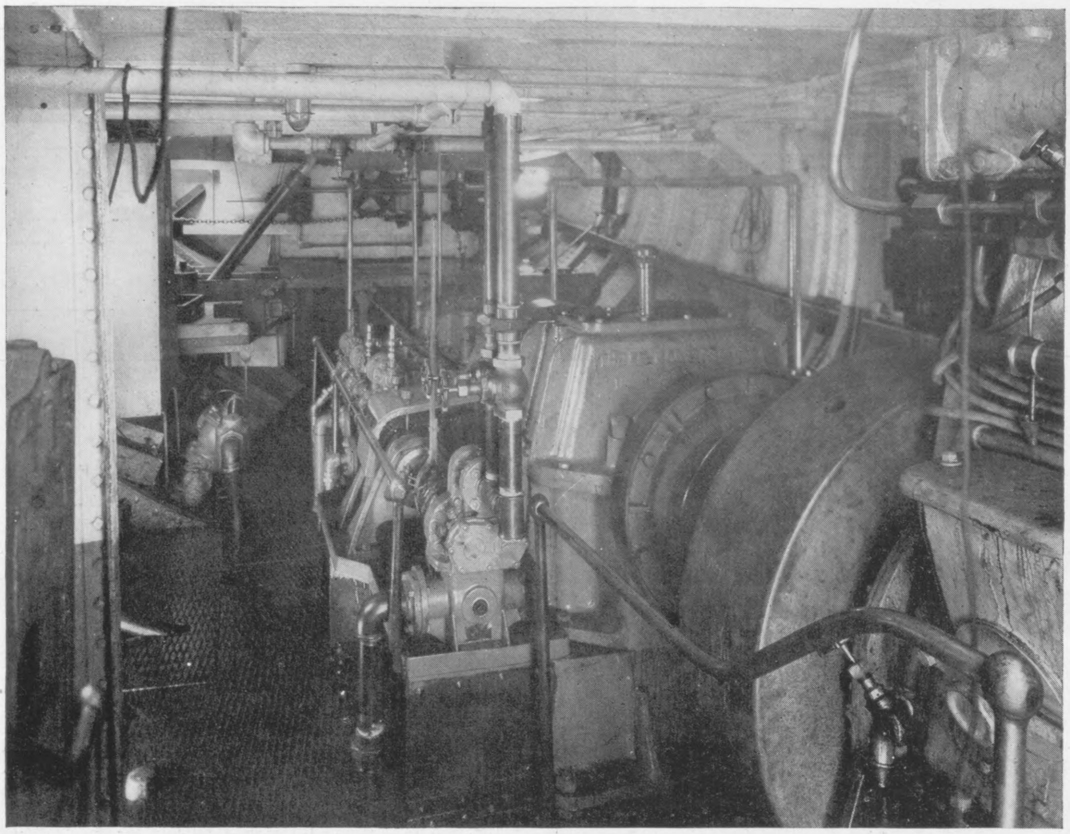
Length, overall	90 ft. 0 in.
Length, on waterline	81 ft. 3 in.
Beam, molded	20 ft. 1 in.
Depth, molded	9 ft. 2 in.
Draft (mean)	10 ft. 4 in.
Main Engine	250 b.hp.

Sistership No. 22 is now converting

The main engine runs normally at 375 r.p.m. while the wheel, a 4 bladed cast iron unit 7 ft. 8 in. in diameter and 10 ft. 6 in. pitch turns for best efficiency at about 125 r.p.m. This difference in revolutions is bridged by the interposition between engine shaft and thrust shaft of mechanical reduction gearing having a reduction ratio of 3 to 1. This gearing is an exact duplicate of that fitted in the towboat CORNELL described in detail in July, 1926, MOTORSHIP, and it is not therefore necessary to enter into any details of its construction here, except to recall that the likelihood of any sudden shocks on the propeller or big variations in load damaging the gear teeth is obviated by the inclusion in the system of 2 Falk-Bibby flexible couplings. One of these is arranged between the thrust shaft and the main gear wheel shaft, while the other is between the engine crankshaft and the ahead driving shaft.

Control of the tug's motion, as in CORNELL, is through the Metten friction clutch operated under oil pressure, one clutch being provided for ahead running and the other for astern running. No starting and stopping of the engine during rapid re-

New York Central Tug runs at 10½ knots, her stack taking the exhaust of a 250 hp. Diesel controlled from the pilot house re-



Four auxiliary pumps are in one line and driven off the gears

versals of direction of motion of the ship is therefore necessary, and the engine operates in one direction of rotation during the whole time it is running. No. 21 differs from CORNELL in that her controls have been taken right up into the pilot house instead of being arranged at top platform level. Also there is a slightly different and more compact arrangement for those pumps which are driven off the gearing.

No. 21 has had a varied but interesting career. Constructed of steel in 1899 at Marvel's Yard, Newburgh-on-Hudson, her deckhouses and pilot house during building were changed from wood to steel, and she was one of the first towboats to be so fitted. Later she was the first towboat in the New York Central fleet to be converted from coal to oil burning and now she has been again converted, this time to Diesel drive. It is commonly reported that owing to the additions in weight caused firstly by the steel deckhouses and secondly by the addition of fuel oil burning plant, No. 21's freeboard decreased considerably, with the result that she was under certain conditions a very "wet" boat. The new machinery installation, however, ensures a minimum freeboard of about 24 inches. At the time she was taken in hand for conversion—May of this year—she was due for re-boilering and it was decided therefore to make a thorough job of the re-conditioning by fitting up-to-date Diesel machinery. Accordingly the original propelling machinery comprising a 15 in, 30 in, by 22 in. stroke tandem compound steam engine taking steam at 150 lb. pressure from a boiler 14 ft. 3 in. long by 96 in. diameter, was removed, and the only part of the old plant now remaining is the thrust block and shaft and the propeller. This latter may be changed later, if found necessary, for the more efficient operation of the plant. The vessel went on service on July 1, the conversion having taken just 2 months. A sister vessel to No. 21—No. 22—is due for conversion in the near future, and her plant has been ordered and is now ready for installation on board. The same type of drive as that adopted in No. 21 will be used in No. 22, but an Ingersoll-Rand engine of the same power will be used for propulsion.

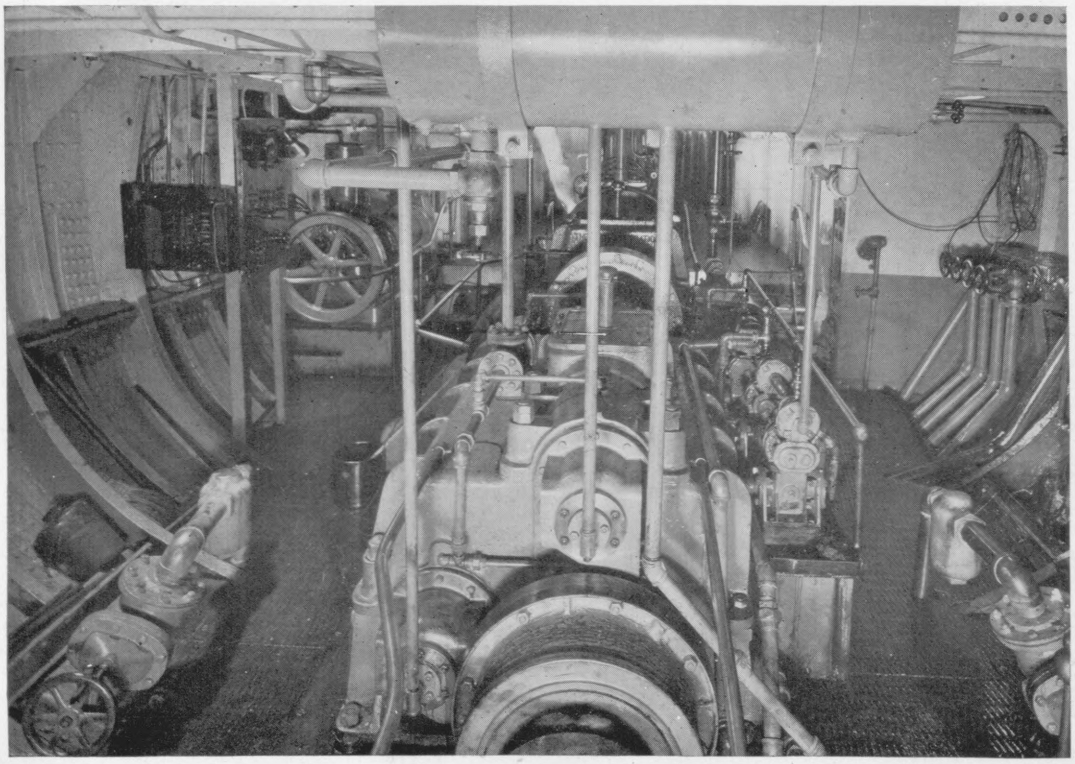
It will be recalled from the description of CORNELL that this entails the center line of crankshaft of the main engine being mounted at a higher level than the center line of the thrust shaft. This is inevitable with the present arrangement of the gears but the space underneath the engine is used very conveniently as a tank of 336 gallons capacity for lubricating oil. It is understood that New York Central is interested in a form of drive for future conversions which will permit of thrust shaft and crankshaft being on the same level and which will at the same time retain all the advantages of the present drive.

No. 21's main engine is a standard 6 cylinder 300 b.hp. Winton Diesel (cylinder diameter 10 in. by 14 in. stroke) running normally at 375 r.p.m. On this vessel, however, the engine does not operate at more than 250 b.hp.

Control of the clutches and engine speed is provided for, in much the same way as in CORNELL, but in this case the control is taken to the pilot house and 2 engine room telegraphs of Chadburn type have been connected direct to the clutch pump control cam for ahead or astern running and to the engine governor for control of speed. In CORNELL control of engine speed is obtained by movement of the fuel lever by the engine cam. The fuel lever on the Winton engine on No. 21 has been removed and all control is done through the governor. Either telegraph may be used by the pilot, and operation is by means of the telegraph handles which are synchronized by means of a 1 in. brass way shaft running across from telegraph to telegraph. The port telegraph is in direct communication with a smaller way shaft underneath the pilot house and this latter, by means of a cam, controls the clutch pump valve. From this way shaft also an eccentric and rod controls the governor on the engine. The pilot himself thus has absolute control of the ship from port or starboard side of the wheelhouse.

The steering gear, operated direct by the wheel in the pilothouse, is of Hyde Windlass Co.'s make, and is of ram type, the piston being operated by oil at 200 lb. pressure. The ram itself is 15 in. diameter by 36 in. stroke, and the principle of operation is the restoration of equilibrium in the system destroyed by the helmsman moving the steering wheel away from the center position.

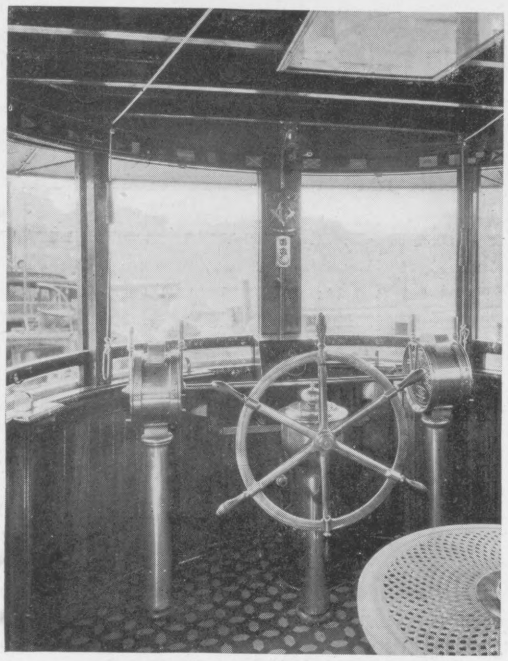
A 50 gallon capacity oil pressure pump driven off the gearing keeps a constant



Gearing with flexible couplings gives a three to one speed reduction

pressure in the system. With the wheel amidships the pump merely by-passes, but with the opening of a valve caused by movement of the wheel, oil enters the cylinder and moves the ram over. Oil on the other side of the ram is at the same time sucked out by the pump, and hunting is taken care of by a cam arrangement operated from the ram. Movement of the wheel back to midships again causes a return of the ram to center position. A 15 gallon tank is connected to the suction for make-up purposes.

Auxiliary machinery in No. 21, considering the comparatively limited space available is very compactly arranged. The gearing drives 4 pumps—a 25 gallon oil clutch pump, a 25 gallon lubricating oil pump for the gears, a 50 gallon bilge pump thrown in or out of operation as desired by a lever clutch, and a 50 gallon steering gear pump supplying oil at 200 lb. pressure for the ram. CORNELL'S pumps driven off the gearing were distributed on either side of the gear casing, but in No. 21 these have all been arranged in line on the starboard side forming a compact set of pump units.



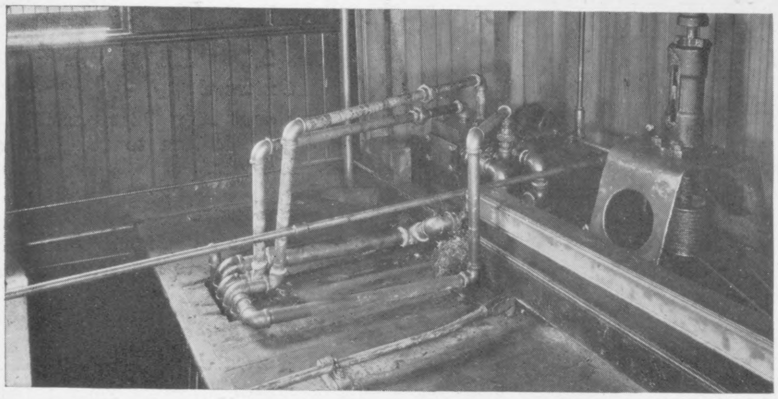
Rudder and engine controls

forward engine room bulkhead with air at 1,000 lb. pressure for starting purposes. A small steam boiler for heating the ship during the winter months is arranged on the starboard side. This burns oil.

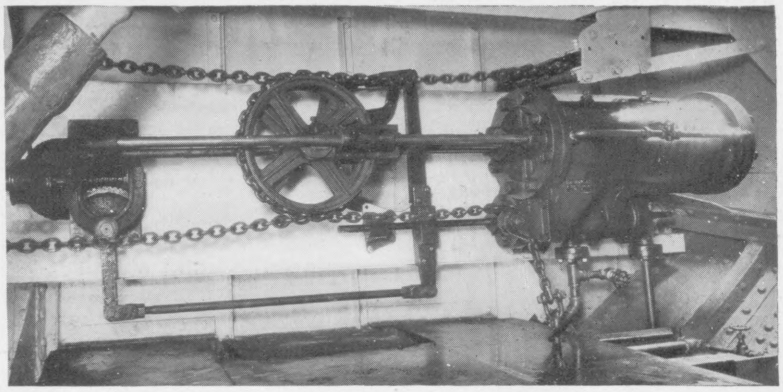
Since No. 21 was using fuel oil under her boiler before conversion to Diesel no alterations in the disposition of fuel tanks were necessary. There are two main tanks one on either side of the engine room extending practically half the length of the engine room. These have each a capacity of 7 tons of Diesel oil.

The daily use tank arranged in the stack has a capacity of 25 gallons. Lubricating oil, as was mentioned, is stored in a 336 gallon tank under the main engine while there is also a lubricating oil filter tank on the port side against the forward end of the fuel oil tank.

No. 21 has a medium sized stack abaft her pilot house which takes the main engine exhaust. She is capable of handling 2 fully loaded car floats at one time, and her fuel consumption is 0.45 lb. Diesel oil per b.hp. per hour.



Clutch pump is arranged under wheelhouse



Steering ram is on engine room bulkhead

They all have small Falk-Bibby couplings arranged on their drives, securing complete elasticity. On the port side at about 'midships is a compressor and generator unit driven by a Hill Diesel. It was particularly desired to avoid the use of gasoline on this ship. This engine drives a 4 kw. generator supplying current for lighting and for driving a ½ hp. motor operating a pump which takes fuel from the fuel tank and delivers to the ready use tank up in the engine casing. This engine also operates a compressor unit charging 8 drawn-steel flasks arranged vertically against the

The installation of a Diesel engine has improved both her freeboard and her stability since the higher position of the center of gravity has increased her metacentric height, with the result that even with the rudder hard over there is little or no tendency to "roll under."

Three Months' Orders Total 180,000 HP.

New Sulzer Engines for Large Motorliners Include Units of 10,700 HP. Per Shaft

INDICATIVE of the big strides now being made by the marine Diesel engine, orders for Sulzer 2-cycle engines during the past three months, to be constructed by the firm's Winterthur works and by various licensees, aggregate no less than 180,000 hp. Attention to several of these orders has already been called in previous issues of MOTORSHIP and among the most interesting is that which the Grace Steamship Company placed for four 5,300 hp. engines, 2 each for a passenger liner intended for New York-South American service. New Zealand Shipping Company's services from London to New Zealand via Panama will shortly be augmented by 2 passenger motorliners containing Sulzer engines, for main and auxiliary purposes, aggregating 62,000 hp. These engines are to be constructed by J. Brown & Co., Clydebank, Scotland, and comprise for each ship 2 main engines of 10,700 hp. each and 8 auxiliary engines of 1,200 hp. each. The ships will be of 20,000 tons each and the engines will be the largest single acting engines constructed up to the present time.

Shaw, Savill & Albion Co., London, is now having constructed for similar service to that of the 2 New Zealand Shipping Company's vessels mentioned above, 2 passenger and freight motorliners of 21,000 tons each. These will be quadruple screw ships having each 4 main engines of 5,675 hp. per unit, giving a service speed of 17 knots. Machinery for one ship will be constructed by the Fairfield Shipbuilding and Engineering Company, who, it will be remembered, built the main propelling machinery for the Union Steam Ship of New Zealand Company's AORANGI.

Both the Shaw, Savill and the New Zealand Shipping Company's new ships will be very fine motorliners. The former will develop an aggregate of 22,700 hp. on 4 shafts while the latter will have 21,400 hp. on 2 shafts. AORANGI, it will be recalled, develops about 16,000 hp. on 4 shafts. When it is remembered that all these powers are reached with single acting engines, it will be realized what enormous strides have been made during the past few years in this branch of Diesel engineering.

Japanese orders for Sulzer engines, of recent date, include three 3,000 hp. engines for 3 single screw motor freighters building for the Mitsubishi Co., Tokio, at the Mitsubishi Dockyards, Nagasaki.

Two- and Four-Cycle Engines Compared

Japanese Transpacific Sister Motorships Atago Maru and Asuka Maru in Operation a Year

NIPPON YUSEN KAISHA'S sister motorships ATAGO MARU and ASUKA MARU, in service on the transpacific run from Japanese ports to British Columbia and the State of Washington since the early part of 1925, both show a good record of operation for the period. Differences in speed and fuel consumption have been so trifling that considering the varying cargoes and weather conditions at sea, the two ships may be taken as practically equal, while the general efficiency and dependability of their engines leaves little to choose between the 2-cycle 4-cycle types of Diesel engines, judging from the records and reports of their engineers upon which this article is based.

The opinion of the officials of the Nippon Yusen Kaisha line as to the comparative merits of the different types of engines they have tried out in these ships will naturally be reflected in their future building programme. It is reported that 3 new passenger liners, vessels of 14,000 tons and 17 knots speed, which this company is to build in Japan for Yokohama-San Francisco service will also be used for making a comparison of the advantages of the 2-cycle and 4-cycle engines, 2 ships being equipped with twin Sulzer single-acting engines with a total of about 12,000 hp., and the third with twin Burmeister & Wain type double acting Diesel engines with a total of about the same power.

ATAGO MARU and ASUKA MARU are sister ships of about 10,500 tons d.w., 454 ft. length overall, 440 ft. length b.p., 57 ft. molded breadth, 38.6 ft. molded depth and 28 ft. mean load draft on a displacement of about 15,000 tons. ATAGO MARU was built by Lithgows, Ltd., Port Glasgow, Scotland, and equipped with 2 sets of 4-cylinder Sulzer engines delivering a total of 4000 s.hp. ASUKA MARU was built by D. & W. Henderson and engined by Harland & Wolff, Glasgow, and equipped with 2 sets of 8-cylinder Burmeister & Wain engines, also rated to deliver a total of 4000 s.hp. ATAGO MARU has three 4-cylinder Sulzer auxiliaries of 200 b.hp. each driving generators. Part of this electric power is used at sea for driving turbo-blowers to scavenge the main engines. ASUKA MARU is equipped with three 150 hp. 3 cylinder auxiliary Diesels connected to generators. Both ships have electric cargo winches.

The engines are the main difference in these two ships, and there is also a little difference in the engine rooms, ATAGO MARU having 56 ft. length of machinery space exclusive of the thrust recess, while the engine room of the ASUKA MARU is a few feet longer. In other respects they are practically identical. ATAGO MARU is reported to have cost $900,000 and ASUKA MARU $1,000,000, the principal difference in cost being the machinery.

These motorships were designed for 12½ knots, with a view to a service speed of 12 knots. On her trials ATAGO MARU is said to have made 14.5 knots, and ASUKA MARU a little over 13 knots. On the average of four round trip voyages on the transpacific run, ASUKA MARU shows 11.76 knots on a fuel consumption of 14.74 tons for all purposes against 11.5 knots for ATAGO MARU on a fuel consumption of 14.3 tons; while ASUKA MARU has averaged as high as 14.2 knots on a good day's run. These runs having been made under different conditions of load, and weather for the two ships, the average speeds can only be accepted for purposes of rough comparison.

After a year's steady operation in transpacific trade, then, ATAGO MARU shows an average of 11.5 knots on an average fuel consumption of 14.3 tons for main engines and auxiliaries. These averages are taken over four round trip voyages between Yokohama and Victoria or Vancouver, but not taking into account the coastal calls in Japan or on the coast of North America. The run across the Pacific ranged from 14 to 17 days.

ATAGO MARU has invariably carried a light cargo outward, and fairly heavy loads back to Japan, so that the eastward voyages show a better average speed. Winds also favored the eastward trip. The best average for a trip was 12.7 knots westbound, and the slowest 10.4 knots eastbound, when in addition to a heavy load there was rough weather with wind and sea principally ahead, and the ship also had a foul bottom.

On some of these voyages severe gales and heavy seas handled the ship very roughly. Throughout, her Diesel engines are said to have performed well, the most serious trouble being a hot main bearing which developed on one trip, but in spite of this the average for that voyage was 11.5 knots which was the best average on the eastward run during the year.

Chief Engineer Y. Aritake says that the average fuel consumption of the main engines at sea is 13 tons per day and the auxiliaries use 1.3 tons per day. The average port consumption, working cargo for 24 hours, is about 0.7 tons of fuel, using two generating sets. Between 200 and 300 gals. of make up oil is added to the bearing lubricating system every round trip of about three months, a half and half mixture of Heavy and Extra Heavy Gargoyle being used.

About 18 gals. a day is the consumption of cylinder oil of the main engines, Gargoyle 600 W. being used. It had been found advantageous to increase the amount of cylinder oil used on the first trips, which was about 12 gals. a day. The auxiliary engines use from 3 to 4 gals. of oil a day.

The following four round trip voyages from Kobe to Seattle from March 8, 1925 to March 1, 1926, give a good idea of ATAGO MARU'S performance, the transpacific part of the voyage between Victoria or Vancouver, B. C., and Yokohama being included for purposes of comparison. Ship is fairly light outward, well loaded homeward.

These averages show the twin Sulzer engines rated to develop 2000 s.hp. each at 100 r.p.m. drove ATAGO MARU through good and bad conditions at an average of 11.5 knots turning a 4-bladed propeller of 15 ft. diameter and 14 ft. pitch at an average of 90 r.p.m. with an average slip of about 7½ per cent, the fuel consumption being 14.3 tons a day for all purposes.

Atago Maru Performance

No. 1 VOYAGE

Outward

12.7 knots; 4.4 per cent slip; about 96 r.p.m.; 15 tons fuel per day. Three days rough wind ahead, two moderate, remainder light on beam and quartering.

Homeward

11.5 knots; 3.4 per cent slip; 76-95 r.p.m.; 13.5 tons fuel per day.

No. 2 VOYAGE

Outward

11.7 knots; 7.6 per cent slip; 92 r.p.m.; 14.5 tons fuel per day. Medium to rough seas principally on the beam.

Homeward

11.2 knots; 9.4 per cent slip; 90 r.p.m.; 14.8 tons fuel per day. Slight to moderate sea on bow and beam.

No. 3 VOYAGE

Outward

12.4 knots; 1.1 per cent slip; 92 r.p.m.; 13.6 tons fuel per day. Moderate beam and quartering wind and sea.

Homeward

10.4 knots; 11.5 per cent slip; 88 r.p.m.; 14.1 tons fuel per day. Rough, sometimes high seas, on bow and beam.

No. 4 VOYAGE

Outward

11.6 knots; 8.2 per cent slip; 94 r.p.m.; 14.7 tons fuel per day. Rough on bow and beam.

Homeward

10.4 knots; 13.2 per cent slip; 88 r.p.m.; 14.1 tons fuel per day. Loaded to full draft, foul bottom, weather rough, mainly ahead.

Taking the average of ASUKA MARU over four similar round trip voyages between Yokohama and Victoria or Vancouver, B. C., starting June 9, 1925, and running into the following summer, her average speed is 11¾ knots, her engines turning a four-bladed propeller of 13 ft. 4½ in. diameter and 12 ft. pitch at 120 r.p.m. with 16½ per cent slip; her machinery rating is 2000 s.hp. each engine at 125 r.p.m. Her fuel consumption for the same time averages 14.76 tons a day for all purposes. Chief Engineer S. Hayashi says that the one auxiliary engine used when running at sea uses about 0.7 tons of fuel per day.

Her lubricating oil consumption is recorded as 3 gals. per day of Vacuum D.T.E. Extra Heavy for cylinder lubrication of the main engines, and 10 gals. a day of Vacuum D.T.E. Heavy Medium oil for bearings, 7 gals. of this being used as made up for the main engine forced lubrication system, and 3 gals. for the dynamo sets.

0.75 gal. of Heavy X oil per day is used for the compressors.

The record of the four round trip voyages of ASUKA MARU is as follows, taking the runs from port to port but giving also the voyage dates:

Asuka Maru Performance

NO. 2 VOYAGE

Outward (leaving Yokohama June 9, 1925)

13.24 knots; 10.42 per cent slip; about 124 r.p.m.; 14.6 tons fuel per day.

Homeward (leaving Vancouver July 10)

11.6 knots; 13.86 per cent slip; about 116 r.p.m.; 13.03 tons fuel per day. Weather outward light to moderate with the wind mainly fair and homeward light to moderate weather with more head winds.

VOYAGE NO. 3

Outward (leaving Yokohama Aug. 31)

12.3 knots; 11.7 per cent slip; about 120 r.p.m.; 13.15 tons fuel per day.

Homeward (leaving Vancouver Oct. 2)

10.74 knots; 21.08 per cent slip; about 118 r.p.m.; 14.8 tons fuel per day. Weather outward light to moderate, and homeward: heavy head winds and gales were experienced.

NO. 4 VOYAGE

Outward (leaving Yokohama Nov. 28)

10.9 knots; 22.36 per cent slip; about 120 r.p.m.; 14.95 tons fuel per day.

Homeward (leaving Vancouver Dec. 30)

12.1 knots; 16.91 per cent slip; about 122 r.p.m.; 17.5 tons fuel per day. Rough weather with heavy gales on the bow outward bound, and homeward mainly light and moderate weather with gales on quarter.

NO. 5 VOYAGE

Outward (leaving Yokohama Feb. 25, 1926)

12.3 knots; 14.6 per cent slip; about 123 r.p.m.; 14.61 tons fuel per day.

Homeward (leaving Vancouver Mar. 27, 1926)

10.9 knots; 21.56 per cent slip; about 120 r.p.m.; 15.33 tons fuel per day. Outward light to moderate winds, principally on the bow and beam; homeward heavy winds.

Average conditions are favorable to making speed on the eastward run, the boats carrying silk and other light cargo, and the winds being mainly fair, while westbound the ships have heavy cargoes of lumber, logs, grain and general merchandise, and usually find head winds. On No. 6 voyage eastbound from Yokohama, ASUKA MARU averaged 12.8 knots drawing 14 ft. 9 in. of water forward and 17 ft. 11 in. aft under favorable weather conditions; while on the previous westbound trip she had only made 10.9 knots, being loaded to 27 ft. 11 in. forward and 28 ft. 4 in. aft, and besides this had heavy seas and head winds to contend with. Both trips were made with the engines turning an average of 120 r.p.m., but it took more than a ton a day more fuel to maintain these revolutions westbound than it had coming east.

The Chief engineer reports having had some minor troubles, such as a couple of cracked pistons, a cracked cylinder and several burned out fuel injection valves, which were easily replaced with spare parts. The main engines are, however, doing splendid work. The consumption of lubricating oil for cylinders and bearings has been reduced from about 19 gals. a day on her maiden voyage to 14 gals. at present. The trouble with the two pistons developed at different times when starting up from cold, and the cylinder had to be cut out till it was convenient to replace the cracked piston.

The trying out of these 2- and 4-cycle types of engines in similar hulls has at least added something to the total of proofs that Diesel engines are powerful, dependable, and economical to operate.

Brazilian Coast to Have 8 Motorliners

South American Shipping Company Orders 14½ Knot Motorship for Coastwise Passenger and Cargo Service

EIGHT passenger motorliners will be in operation in Brazilian coastwise service when all contracts at present in hand for the Companhia Nacional de Navegacao Costeira and its associated company the Lloyd Nacional of Rio de Janeiro are completed. Four of these motorships are being built by the Cantiere Navale Triestion and will be powered by Fiat engines of 4,250 b.hp. Three are under construction by Beardmore & Co. in Scotland and will have Beardmore-Tosi engines of about 4750 i.hp. The eighth vessel is the ITAPAGE now completing at the yard of the Chantiers and Ateliers de St. Nazaire and powered by B. & W. engines of 3550 b.hp.

Chief characteristics of the ships

Length between perpendiculars	370 ft. 0 in.
Beam, molded	52 ft. 0 in.
Depth, molded	26 ft. 9 in.
Draft, mean	20 ft. 6 in.
Deadweight	3800 tons
Displacement (about)	7600 tons
Speed (trial trip)	14½ knots

The Italian ships are reported to have a slightly greater beam (1 ft. 6 in.) and molded depth (9 in.), otherwise details of general arrangement are the same in all ships. All will have a straight stem, counter stern, two pole masts and single stack. They will be of "three island" type with a forecastle, long bridge—above which are promenade and boat decks—and a poop. There are three cargo holds forward of the machinery space and two abaft, No. 3 hold being entirely sheathed with cross boarding for the carriage of salt.

Accommodation is to be provided for about 145 passengers in first, second and third class. First class quarters are amidships and include a large dining room and a music room at the forward end of the midship erection and a smoking room and a veranda café at the aft end. Two refrigerated compartments have a total capacity of 20,000 cu. ft. These are in the 'tween decks and are to carry meat and fruit. Cargo is taken care of by 10 hydraulic cranes of 1½ tons capacity apiece, and two of 3 tons each serving No. 2 hold. An electric warping winch is fitted aft on the poop deck and a similar boat hoisting winch on the smoking room top.

Powering in the four Italian-built ships is to be carried out by two sets of 4-cylinder Fiat engines to develop on trial 4250 b.hp. at about 133 r.p.m. The cylinder dimensions will be about 27 in. by 38 in. Auxiliary machinery is to be all electrically driven, and current for this purpose will be supplied by three 80 kw. generating sets driven by twin cylinder Fiat Diesels. There is also an auxiliary generator driven by a 25 b.hp. Fiat surface-ignition engine running normally at 425 r.p.m. The steering gear is of electric-hydraulic type, controlled by telemotor from the bridge.

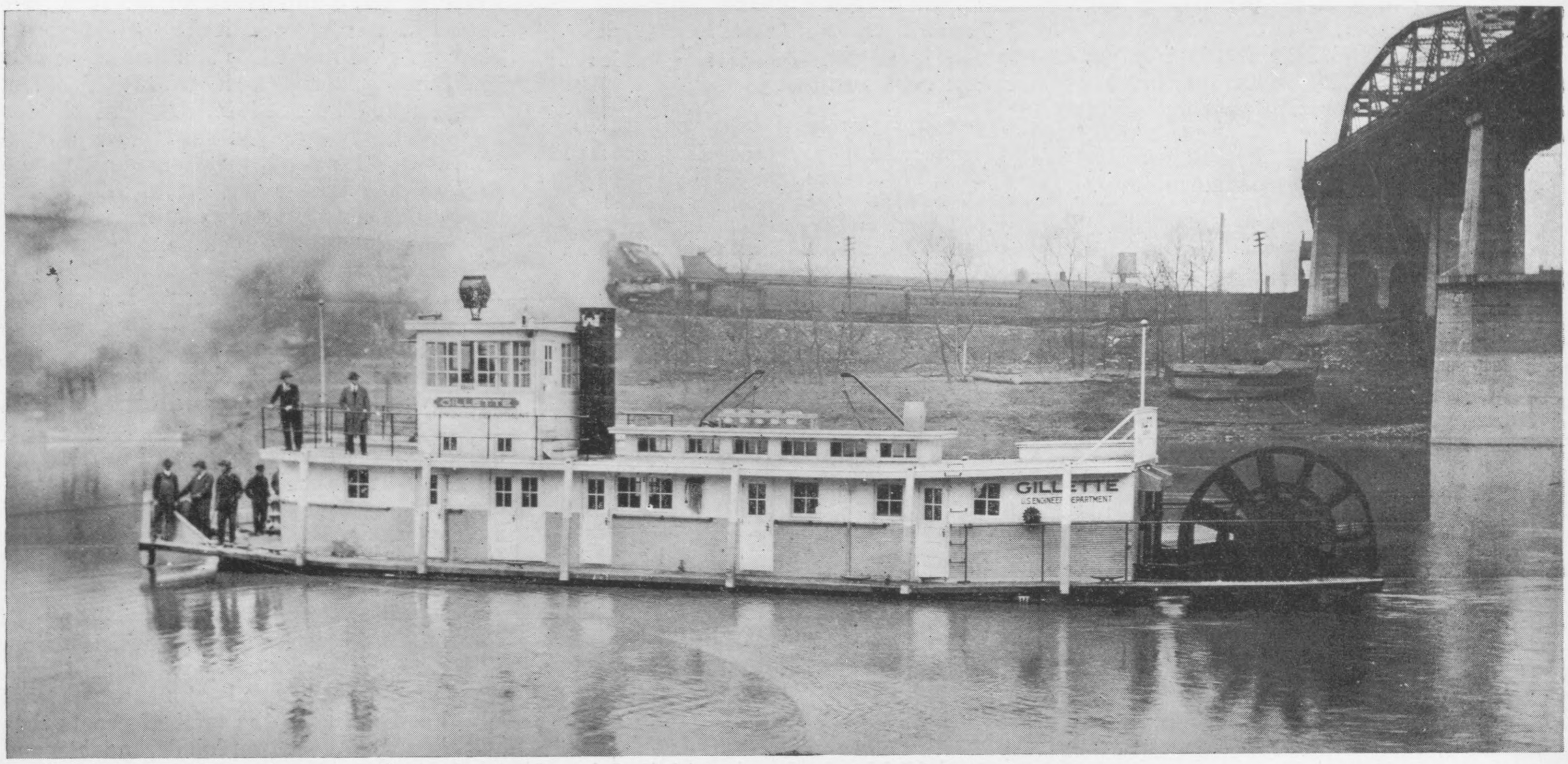
The 3 British-built ships will have two 6-cylinder Beardmore-Tosi engines fitted with superchargers, the two first supercharged Diesel engines constructed in Great Britain. The total power to be developed, with supercharging, is 4750 i.hp. at about 140 r.p.m. A combination electric and steam system of drive for the auxiliary machinery has been adopted.

ITAPAGE has two 6-cylinder B. & W. engines developing a collective power of 3550 b.hp. All-electric auxiliaries are fitted.

When these eight ships are in operation, Companhia Nacional de Navegacao Costeira will total 11 motorships in its fleet. Of the three at present in service two of just over 1000 tons gross have Sulzer engines, while the third of 767 tons gross has Kromhout surface-ignition engines.

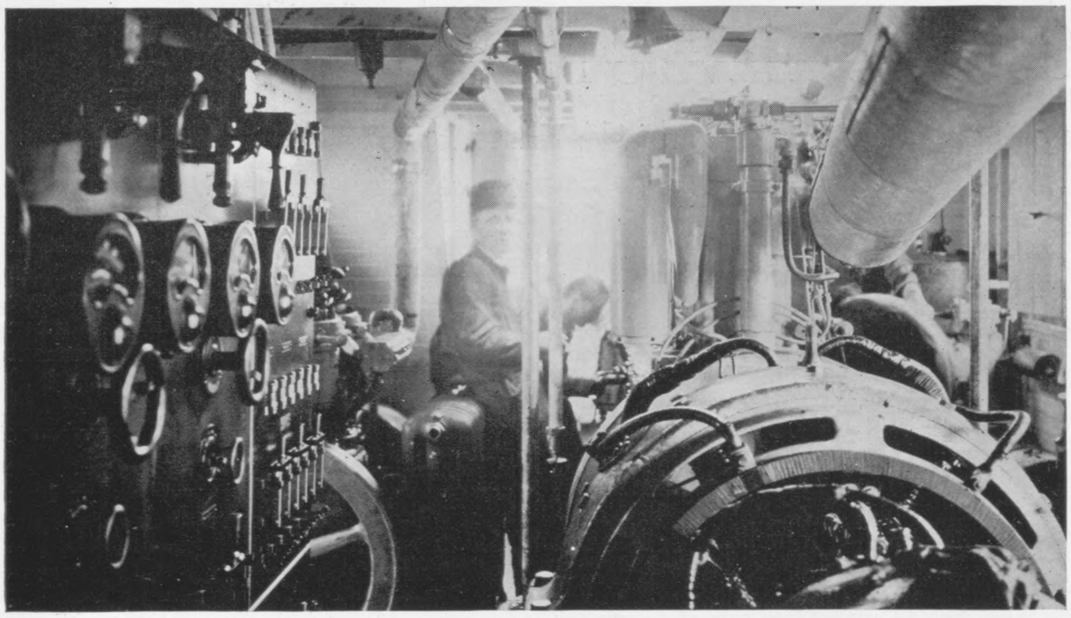
"Times change ———" is an old and hackneyed proverb. It forms nevertheless the burden of a communication which has been sent us by a correspondent who had occasion to visit the Swedish-American motorliner GRIPSHOLM during her latest stay in New York. Our correspondent is a motorship enthusiast and he was considerably impressed by GRIPSHOLM lying spotless on one side of the dock taking on her fuel quickly and silently by means of pumps from a lighter alongside. On the other side of the dock was another passenger liner —a coal burning ship—also taking on fuel. The contrast, he informs us, was striking even to the hardened technical eye, but what appealed to him most was the fact that apparently GRIPSHOLM was obliged to cover parts of her upper structure in canvas shrouds in order to protect their white surfaces as well as the spotless surfaces of the decks and the interiors of the cabins behind them from the ill effects of coal dust.

A twin screw motoryacht EROS, 214 ft. long overall, 32 ft. molded beam and 18 ft. molded depth, is now being fitted out at the Ramage & Ferguson yard, Leith, Scotland. The main engines are 6-cylinder sets built by Burmeister & Wain to develop 800 s.hp. each at 310 r.p.m. Two Diesel generator sets of 66 kw. capacity are provided.

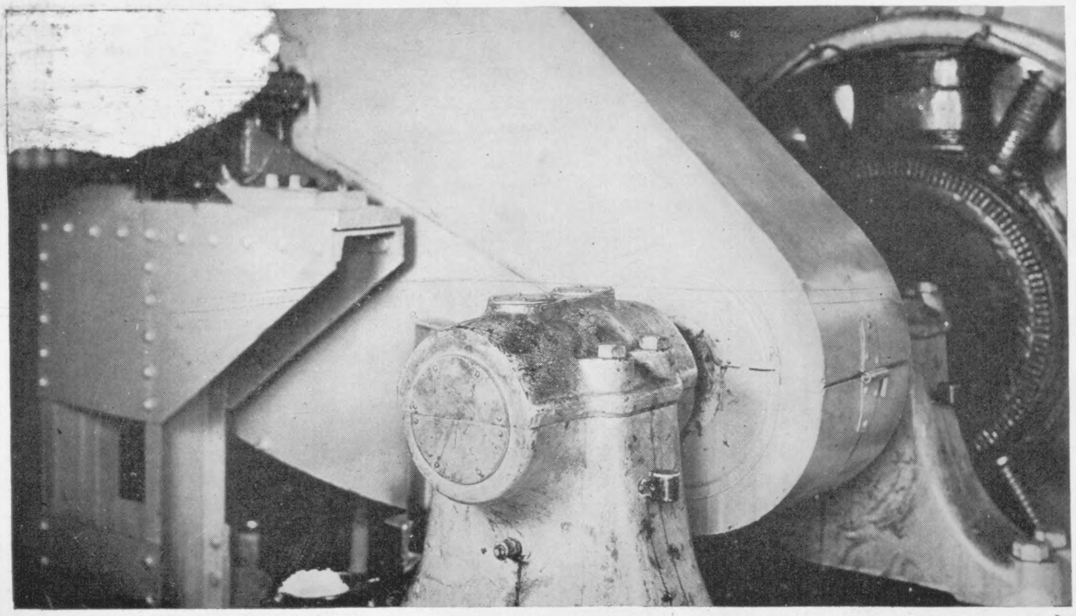


Gillette develops 100 s.hp. at the sternwheel belt driven from a motor arranged aft operated by a Diesel generator forward

Diesel-Electric Sternwheel Tugs for Western Rivers



Diesel generator is of 85 kw. and 240 volts rating



Propelling motor is alongside belt drive to wheel

11 *ft.* 4 *in. diameter Sternwheel*

Gillette and Burnett Delivered to U. S. Engineers, Cincinnati

Two Diesel-Electric Sternwheel Tugs

Gillette and Burnett Completed for U. S. Engineers' Office, Cincinnati, Have Belt Drive

GILLETTE and Burnett two 85 ft. shallow draft Diesel-electric sternwheel towboats ordered early last year by the U. S. Engineer's Office, Cincinnati, have recently been completed by the Nashville Bridge Co., Nashville, Tenn. Following are the chief characteristics of the vessel—

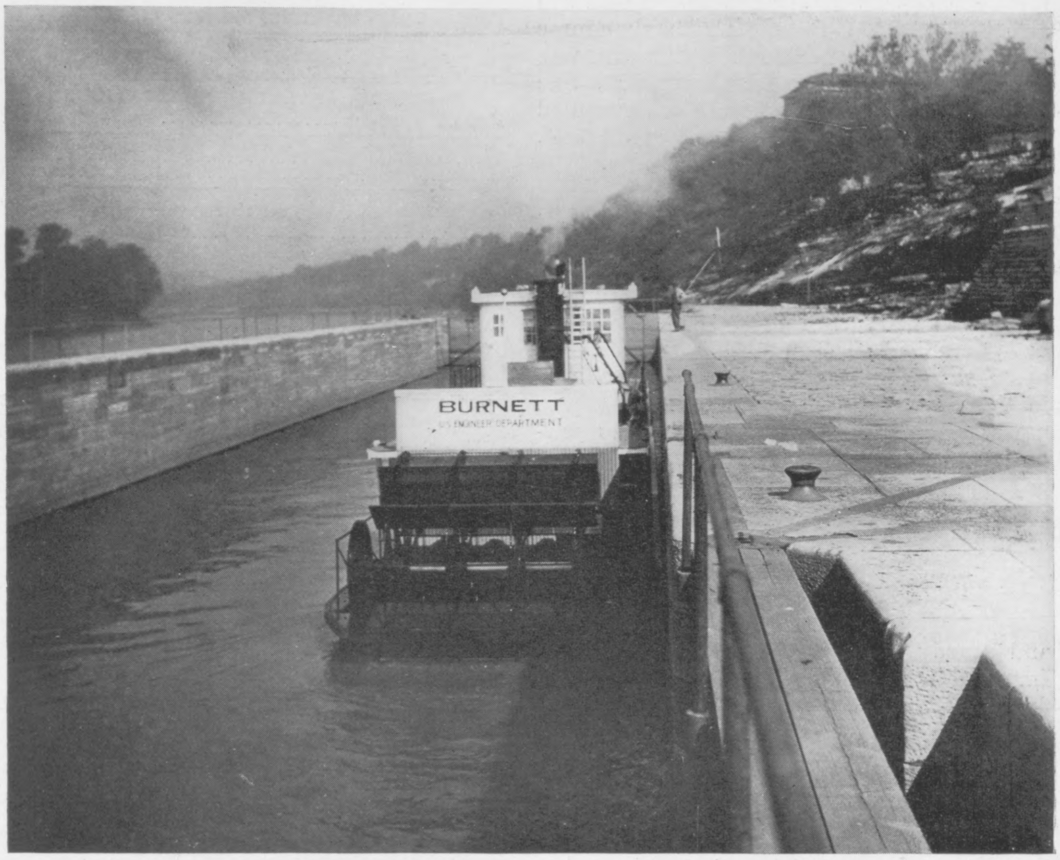
Gillette and Burnett Characteristics

Length overall	85 ft. 2¼ in.
Length, md.	70 ft. 0 in.
Breadth, extreme	17 ft. 0 in.
Draft, mean	2 ft. 6 in.
Power, at sternwheel	100 s.hp.

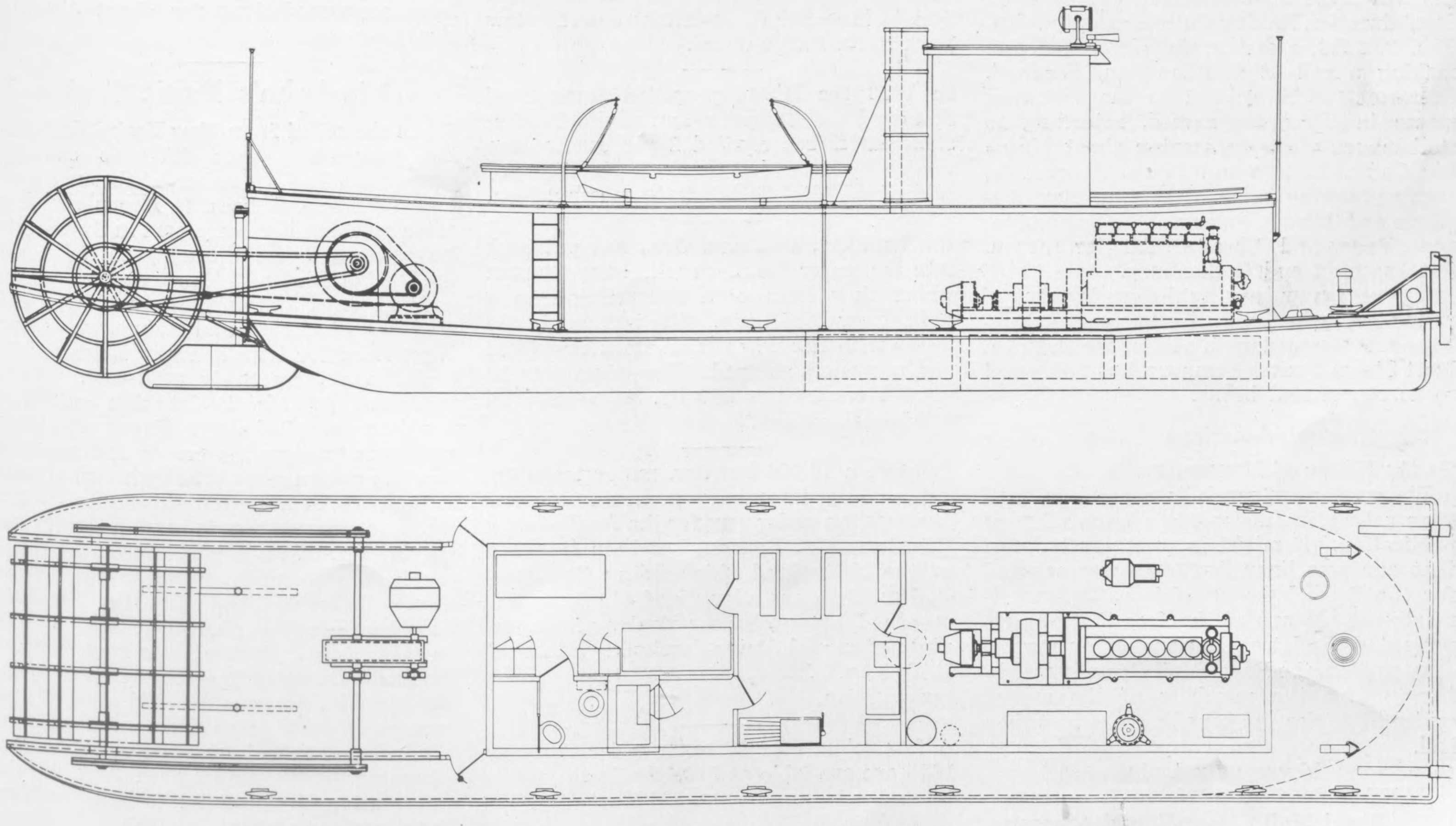
The main engine is a 150 hp. Winton unit direct coupled to a d.c. generator of 85 kw. capacity at 240 volts, with exciter of 7½ kw. capacity at 120 volts. The propelling motor is of the open type, shunt wound, designed to develop 100 s.hp. at speeds between 300 and 600 r.p.m.

Pilot house control is arranged for on the Ward-Leonard System. The drive to the sternwheel is by means of a silent link belt-drive of Link type with a reduction in speed of 4.67 to 1. The sternwheel is 11 ft. 4 in. diameter by 11 ft. wide.

An auxiliary air compressor is provided, capable of compressing 10 cu. ft. of free air per min. to 1000 lb. pressure. This is driven by a 115 volt d.c. motor mounted on the same bed-plate. The auxiliary generating set is an oil engine direct connected to a 7½ kw. 120 volt d.c. generator.



Size of Burnett is shown in comparison with lock of river on which she operates



Gillette and Burnett are powered with a 150 hp. Diesel giving current to a 100 s.hp. motor driving an 11 ft. 4 in. wheel

NEWBURGH, a ferryboat purchased by the Claiborne and Annapolis Ferry Company from the Erie Railroad Company has been converted to Diesel drive at the Staten Island Shipbuilding Company, New York. She is now powered with 4 Fairbanks-Morse Diesels of 360 hp. each, driving twin screws at either end. There are also two 45 hp. C-O type Fairbanks-Morse engines driving generators. NEWBURGH was originally a sidewheeler built in 1883. She has a length b.p. of 193.5 ft., a beam molded of 36 ft. and a depth molded of 13.3 ft. Her original engines were of 800 i.hp.

Atlas-Imperial Busy

Production at the Atlas-Imperial Engine Co.'s plant at Oakland, Cal., continues at a very high rate. For many months orders have been booked at an average rate of 5000 hp. per month, keeping the shops working to the limit. The Atlas-Imperial was the first airless-injection engine put into production in the United States, and it now has behind it an enviable record of long success which has stamped it with the seal of dependability that counts for so much in winning favor. From the time it was first introduced it has had no setback. The story of the company has been one of steady and sturdy growth, until now the Atlas-Imperial Engine Co. is regarded as being financially one of the strongest institutions in the West.

Cruising Motorliners

The passenger motorliner is now breaking into the ocean cruising industry. Announcements have already been made that ASTURIAS of the Royal Mail Steam Packet Company is to make an African cruise from New York early next year. GRIPSHOLM, of the Swedish-American Line, makes a Baltic cruise this month, while early in 1927 she will make Mediterranean Cruise of 47 days' duration leaving Gothenburg, Sweden, Feb. 3, 1926, crossing the North Sea and making a call at Southampton, England. GRIPSHOLM will proceed to the following places in the order named, returning to Gothenburg via Southampton about March 20: Cadiz, Algiers and Tunis, Alexandria, Haifa, Constantinople, Phaleron Bay, Piræeus and Athens, Palermo, Naples and Monaco, Palma and Gibraltar, Tangier, Lisbon, Southampton and Gothenburg.

The reason underlying the employment of motor liners in the cruise business is perhaps best summed up in a letter which Royal Mail Steam Packet Company has addressed to us reproduced below.

Asturias' African Cruise

To the Editor of MOTORSHIP:

We were very much interested to read your article in this month's issue of your publication. It might interest you to know that our new liner ASTURIAS was selected for the Second Great African Cruise primarily on account of the fact that she represented the latest development in marine construction, the Royal Mail Company wishing to give the members of the second cruise to Africa the benefit of the best they had.

Yours very truly,
SANDERSON & SON, INC., Agents
Royal Mail Steam Packet Company.

Motorship

Trade Mark Registered
Founded 1916
Contents copyright, 1926, MOTORSHIP
Published monthly at 220 W. 42nd Street, New York

MOTORSHIP
is a member of the
FREEMAN-PALMER PUBLICATIONS
MILLER FREEMAN.................RUSSELL PALMER

Thos. Orchard Lisle.......................Editor
Russell Palmer.........................Manager

Offices of MOTORSHIP
NEW YORK....................220 W. 42nd Street
Editorial, Advertising and Subscriptions
Cable address—MOTORSHIP, New York
Telephone: Wisconsin 2053
SAN FRANCISCO.............417 Montgomery Street
Telephone: Douglas 6974
SEATTLE ....71 Columbia Street
Telephone: Elliott 4715

ANNUAL SUBSCRIPTION RATES

Domestic	$4.00
Mexico	4.00
Canada	5.00
Other countries (Postal Union)	5.00

Single copies: United States, 35 cents.

MOTORSHIP is published on the 20th of the month prior to the title month of issue, and all changes and any copy for advertising must be received by the publisher not later than the 5th of the month, if proofs of the copy are desired. Notice of discontinuance of advertising must be given 30 days in advance of publication of the magazine.

Readers are invited by the Editor to submit articles, photographs or drawings relating to motorships, marine oil-engines or auxiliaries. Contributions used in the magazine are paid for on the 15th of the title month of issue, and other contributions are returned as promptly as possible.

Plans have been prepared by W. T. Donnelly, 17 Battery Place, N. Y., for a 450 hp. Diesel-electric auto and passenger ship for Baltimore and Norfolk service.

Port & Canal Transportation Co., 25 Beaver St., New York City are contemplating construction of 5 tugs and 25 barges. The tugs are to be of Diesel type and the whole fleet is intended for operation on the New York State Barge Canal.

In 1923 the Diesel propelled tonnage of Standard Oil Company and of its foreign subsidiaries represented 2 per cent of the total. By the end of this year about 35 per cent of the total fleets will be motor driven.

Portland Co., Portland, Ore., has put back into the water the stern wheel tug SHAVER which they have been converting into a twin screw Diesel tug. She was put in the water with her new tunnel stern completed and propellers shipped. Powering is to be carried out by two 350 hp. Atlas-Imperial full Diesel engines.

PHOBOS, a 10,000 ton d.w. motor tankship, one of an important program of new construction under way for the Anglo-Saxon Petroleum Co., London, has been launched by the Netherland Shipbuilding Co., Amsterdam. She has a length of 440 ft., and is propelled by Werkspoor double-acting engines of special design developing a total of 3500 b.hp. Six similar ships are under construction.

A few volumes of MOTORSHIP for the year 1925 are available at $10. Write to Circullation Dept., MOTORSHIP, 220 West 42nd St., New York, N. Y.

On June 1, the total number of motorships under construction or on order equipped with Burmeister & Wain Diesel engines amounted to 80 ships with a total i.hp. of 352,935 representing a total deadweight of 506,529 tons. In addition 71,132 i.hp. auxiliary engines and other types of Burmeister & Wain Diesel engines, such as submarine units, are also under construction.

Reflecting Japanese opinion as to the value of the Diesel engine for marine propulsion a well known shipping man in Tokyo makes the following statement: "The winner of the sea trade route will be the operator who can bring about the most economies on his ships. The Diesel engine, I believe, is the engine of the present. It affords opportunity for cheaper operation and if conditions continue as they are today the Diesel engine is the engine of the future."

Bermuda Motorliner's Engines

Fairfield-Sulzer 2-cycle engines have been selected to power the 530 ft. passenger and cargo liner which Workman, Clark & Co., Ltd., Belfast, Ireland, are to construct for Furness Withy's New York-Bermuda service. The new ship is to be delivered in about 18 months and should then be in service in time to take up the winter season sailings for 1927-28. The new ship will be fitted up very luxuriously and is intended to handle the increasing tourist traffic between New York and Hamilton the capital of Bermuda. With a length of about 530 ft. she will be longer than FORT ST. GEORGE and FORT VICTORIA, the 2 vessels at present engaged on this run which are propelled by quadruple expansion steam engines taking steam from oil fired water-tube boilers. These ships have a speed of 15½ knots and are scheduled to run between their terminal points in 48 hours, a speed of about 15½ knots being required to do this. They have accommodations for about 400 first class passengers.

Gripsholm's Baltic Cruise

When she sailed from New York July 3 with her passenger space filled to capacity, GRIPSHOLM had a number of through bookings for Finland, because a couple of days after reaching her home port in Sweden she leaves on a cruise through the Baltic and the Gulf of Finland. The cruise will extend over 11 days and embraces visits to Helsingfors, Stockholm and Malmo, where time is provided for trips ashore. Rates for the cruise are attractively moderate, with a minimum of $67 in the 1st cabin and $37.50 for the tourist 3rd class. These rates cover stateroom during the cruise and meals at sea, but passengers eat at their own expense at the ports of call. For this cruise the 2nd cabin accommodation is combined with the regular 1st. cabin, a combination for which provision was made in the design of the ship. It is doubtful that the Swedish-American Line has planned to make a profit on this cruise. Instead, one may surmise, the moderate rates have been offered to enable the Line to have the ship clear of passengers in port, so that guests may be invited aboard to look over the vessel. After returning to Gothenburg on July 26 the motor liner is scheduled to sail for New York two days later.

World's Motorship Construction

MOTORVESSEL tonnage building throughout the world was equal to 82 per cent of the steam tonnage under construction at June 30 last, the same ratio as in the returns of March 31, 1926, according to Lloyd's Register of Shipping. Oil engine power under construction has advanced during the same period and is now equal to 90 per cent of the steam power on order contrasted with 83 per cent on March 31 last.

For vessels of all types the world's construction returns just issued constitute in the aggregate a new low record, well below the 1913-1914 level. The tonnage reported building at June 30 was 1,970,000 gross tons, a decline of 40,000 tons compared with March 31, 1926, and 400,000 tons less than a year ago.

An improvement is registered in the United States, however, the work reported by Lloyd's Register—which is, of course, only the work in the large yards—having increased from 117,777 gross tons at March 31 to 133,268 gross tons at the end of June. This is more than 40,000 gross tons better than at the corresponding date last year. Tonnage building in the United States is only slightly less than in Germany, Holland and France. One good sized ship order would now lift the United States into third place in the world's list.

World's Shipbuilding Returns

	Tons Gross June 30, 1926	Tons Gross March 31, 1926
Motors	885,100	913,099
Steam and sail.	1,085,587	1,097,107
Total	1,970,687	2,010,206

Lloyd's Register records 77,600 tons gross of vessels on which work has been ordered suspended in British and Irish shipyards. The total steam and sail tonnage under active construction was therefore only 1,008,000 gross tons at June 30 last. Making allowance herefor, the motorships under construction are actually equal to 88 per cent of the steam and sail tonnage on which work is proceeding.

The quarterly returns do not always show the tonnage on which work has been suspended and one cannot therefore base the comparisons always on the active work alone. Similar confusion arises in the returns of horsepower under construction: at June 30 the turbine power was given in terms of s.hp., whereas at March 31 last it was quoted in i.hp.

World's Engine Building Returns

	June 30, 1926	March 31, 1926
Oil engines...	782,216 i.hp.	733,496 i.hp.
Turbine	399,740 s.hp.	362,415 i.hp.*
Other steam..	370,594 i.hp.	432,968 i.hp.

Omitting the British shipbuilding and engine building returns the motorship and oil engine are far ahead, motorships equalling 591,556 tons gross compared with 404,525 tons gross for steam and sail, and 504,007 i.hp. of oil engines compared with 413,005 i.hp. for steam.

* "i.hp." may be an error in the returns.

Fiat Engines for La Playa

UNITED FRUIT COMPANY, in deciding to re-engine LA PLAYA, one of its two 3,830 ton Diesel-electric fruit carriers, with Fiat engines, at the same time will increase the power for propulsion and the speed of the ship. LA PLAYA was one of a group of 3 ships built for the Boston Company by Cammell, Laird & Company, Birkenhead, England, in 1923, and fitted with Cammel-laird-Fullagar engines of 825 b.hp. each coupled to 500 kw. generators supplying current to a 2,500 b.hp. main propulsion motor. The whole of the electrical equipment was furnished by the British Thomson-Houston Company, Rugby, England. Of the three ships, LA PLAYA and LA MAREA, were fitted with Diesel-electric propulsion, as designed, while the third, LA PERLA, was eventually finished off as a steamer with triple expansion engines and oil-fired boilers.

When the re-engining of LA PLAYA was considered, owing to the smallness of the Camellaird-Fullagar engine, it was difficult to find an engine of a normal type which would go into the same space, without moving either the forward engine room bulkhead or the electric generators. It was an essential condition of the contract that such alterations should not be made, and this has been admirably fulfilled by the particular design of Fiat engine now under construction.

The engines will have 4 working cylinders, one scavenging pump with 2 pistons in tandem and one injection air compressor, making 6 cranks in all. The scavenging pump is located at the dynamo end of the engine and the three stage air compressor at the forward end, this arrangement giving an excellently balanced engine. The unbalanced forces and couples it is stated will be about half the magnitude of those set up by the existing engines.

The working cylinders will be entirely separated from the crankchamber by a diaphragm, so that no carbonized lubricating oil or incidental water leakage from the pistons can have access to the forced lubrication system.

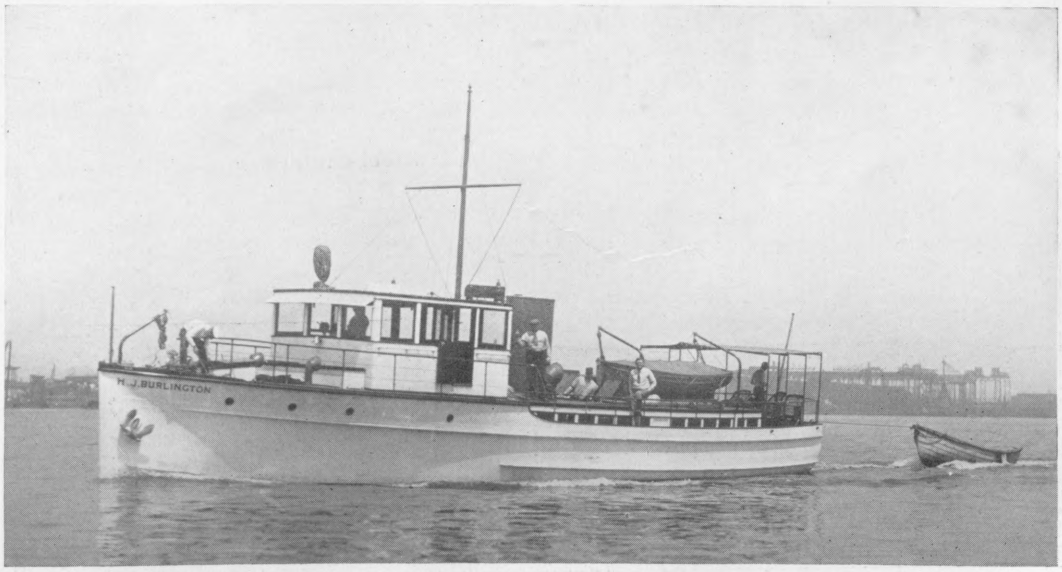
Throughout the severe tests that this ship has been subjected to, the electrical portion of the installation, which was built by the British Thomson-Houston Company of Rugby, has worked perfectly, and no alteration whatever will be made in the electrical installation during the re-engining of the vessel.

Fishery Patrol Cruiser

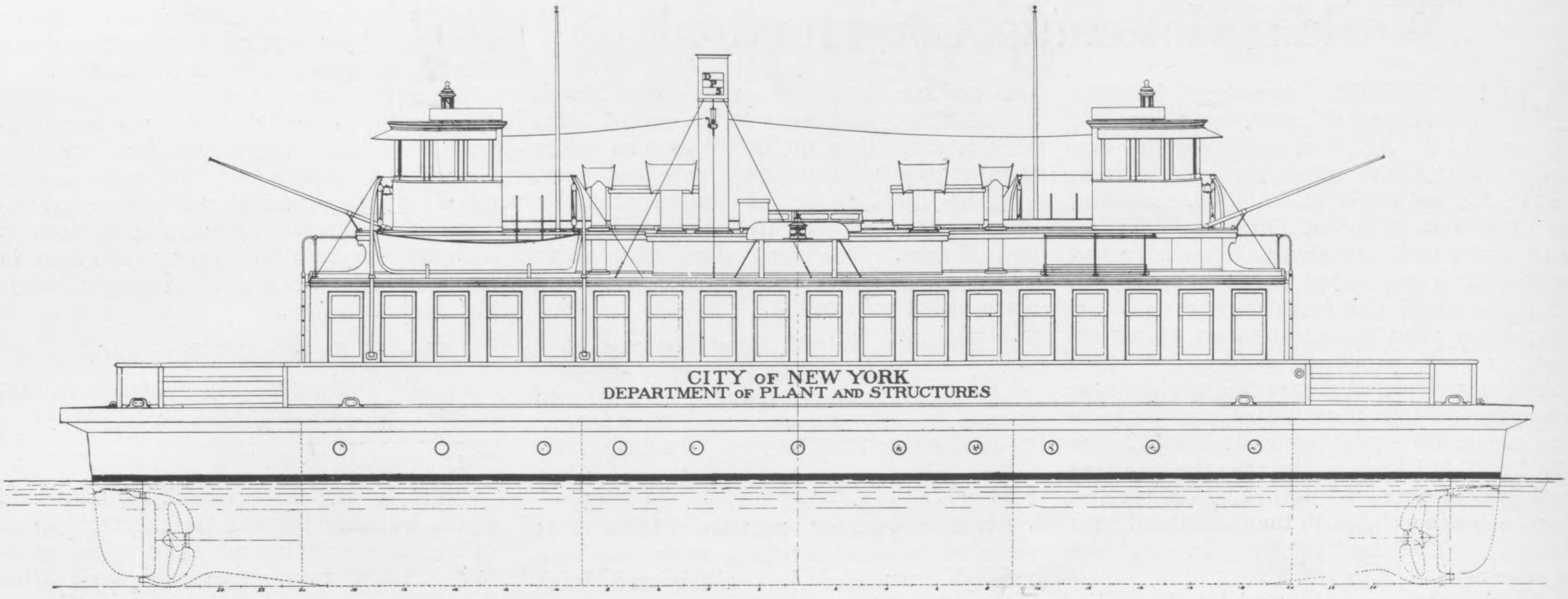
Better protection of food fish along the New Jersey coast as well as more effective enforcement of conservation laws on bays and inland streams is assured through plans of the State Fish and Game Commission who have put into service a new and speedy patrol boat. A falling off of seashore angling in recent years has been attributed to the encroachments of fishing vessels which violate the law by using their nets too close to the shore and the inlets. Lack of a serviceable craft for ocean operations in the pursuit of such violators and for the more effective inspection of operations of fish ponds has heretofore handicapped the wardens. The increasing value of lobster fisheries off the Jersey coast also calls for more supervision. The new service boat built at the Mathis shipyards in Camden has been planned to meet all such requirements. It provides a combination of seaworthiness and speed for ocean work with a sufficiently light draft to permit its operation in shallow streams. The boat has a length of 70 ft. with a 16 ft. beam and a draft of only 5 ft. It has a 6 cylinder Standard Diesel motor of 150 hp. and produces about 13 m.p.h. speed at a cost of about 60 cents an hour.

The ship will be used also in supervising shad-fishing in Delaware River and Bay, and bay fishing at other seasons of the year. A return of the shad to the Delaware in increasing numbers has brought indications of a revival of this once flourishing industry.

A 200 ton auxiliary motoryacht for the Duke of Westminster is being built at the Orlando Shipyard, Leghorn, Italy.



Fishery Patrol Cruiser H. J. Burlington has 150 hp. Diesel



New York's proposed ferries for passenger and vehicular work are of direct Diesel driven type with twin stacks

Diesel Ferries for New York

AT the time of going to press, no definite award has been made for the construction of 2 or 3 steel Diesel driven ferryboats to be used in connection with public institutions operated by the City of New York, but further details of the vessels are now to hand. Bids were taken on these boats in June and the matter is under consideration. The vessels are of considerable interest since they will be the first Diesel propelled passenger and vehicular ferries operated by the Department of Plant and Structures. They are to be double ended vessels with one driveway for vehicles and two cabins for passengers on the main deck. The hull will be of steel and divided into 5 water tight compartments. The deck superstructure is to be constructed of wood.

Propelling machinery will consist of a 6 cylinder, trunk piston type, direct reversing Diesel engine of 4-cycle type developing about 300 s.hp. The engine will be equipped with all necessary auxiliaries for its operation and will be built to start with compressed air on all cylinders in such a manner that it will start in any position. Control will be centralized at one location of the engine and manoeuvering will be carried out from this position in response to signals from the wheel house. The engine will be direct connected to a cast steel propeller, at either end of the hull, having a diameter of 5 ft. 3 in. and a pitch of about 5 ft. There will be 2 stacks arranged side by side, the port one containing a 10 in. diameter fiue from the accommendation heating boiler, while the starboard one contains a 7 in. exhaust pipe from the main engine and two 2½ in. exhaust pipes from the generator engine. There will be two direct connected generator sets of 15 kw. each driven by full Diesel engines. Engine direction and revolution indicators are to be located in each pilot house.

Dimensions of New York Ferryboats

Length, over guards	101 ft. 6 in.
Length, over stern posts	97 ft. 10½ in.
Breadth, over guards	30 ft. 0 in.
Breadth, molded at deck	26 ft. 7 in.
Depth molded	11 ft. 11½ in.

The maximum draft is 6 ft. 8¾ in. with a corresponding displacement of 204 tons. The rudders are of balanced type.

Cornell Co. Adds 2 Diesel Tugs

Cornell Steamboat Company, New York, has recently purchased the tug LION from the New London Ship & Engine Company, this boat being a duplicate of JUMBO and equipped with a 600 hp., 6 cylinder Nelseco engine. JUMBO and LION both have engines direct connected to the propeller which are direct reversible. These tugs will be chiefly used in handling the heavy stone and gravel tows, as well as towing barges from New York to Albany.

Two years ago Cornell Steamboat Company, after severe tests, purchased JUMBO, a 600 hp., 100 ft. by 26 ft. and 12 ft. draft Nelseco engined tug and they have been using this boat on their heavy Hudson River tows. The savings and other features of this tug convinced them of the superiority of Diesel over steam propulsion for their work and within the last two years they have consequently added two more Nelseco Diesel tugs to their fleet, namely CORNELL and ELI B. CONINE. CORNELL and CONINE are equipped with Nelseco engines of 330 hp. each connected to the propeller through a special reduction and reversing gear described in July, 1926, MOTORSHIP.

Cornell Steamboat Co.'s new tug Lion has a 600 hp. Diesel

New York-Far Eastern Services will shortly be augmented by six more 13-14 knot motor freighters, which are to be built to the account of Silver Line, Ltd., managed by Kerr Steamship Lines, Inc., New York. SILVERASH, first of this group, was launched on June 10 by J. L. Thompson & Sons, Sunderland, England. She is propelled by a 4-cylinder Doxford opposed piston engine developing 5000 b.hp. at 90 r.p.m. and will be over 3 knots faster than the 6 motor freighters at present operated by Kerr Steamship Lines. The engine has a cylinder diameter of 26½ in. and the stroke of each piston is 54 in. About 1250 b.hp. per cylinder is developed.

W. C. Kelly Barge Line of Charleston, W. Va., is in the market for the construction of 12 all-steel Diesel barges and tow boats.

San Francisco's Diesel-Electric Ferries

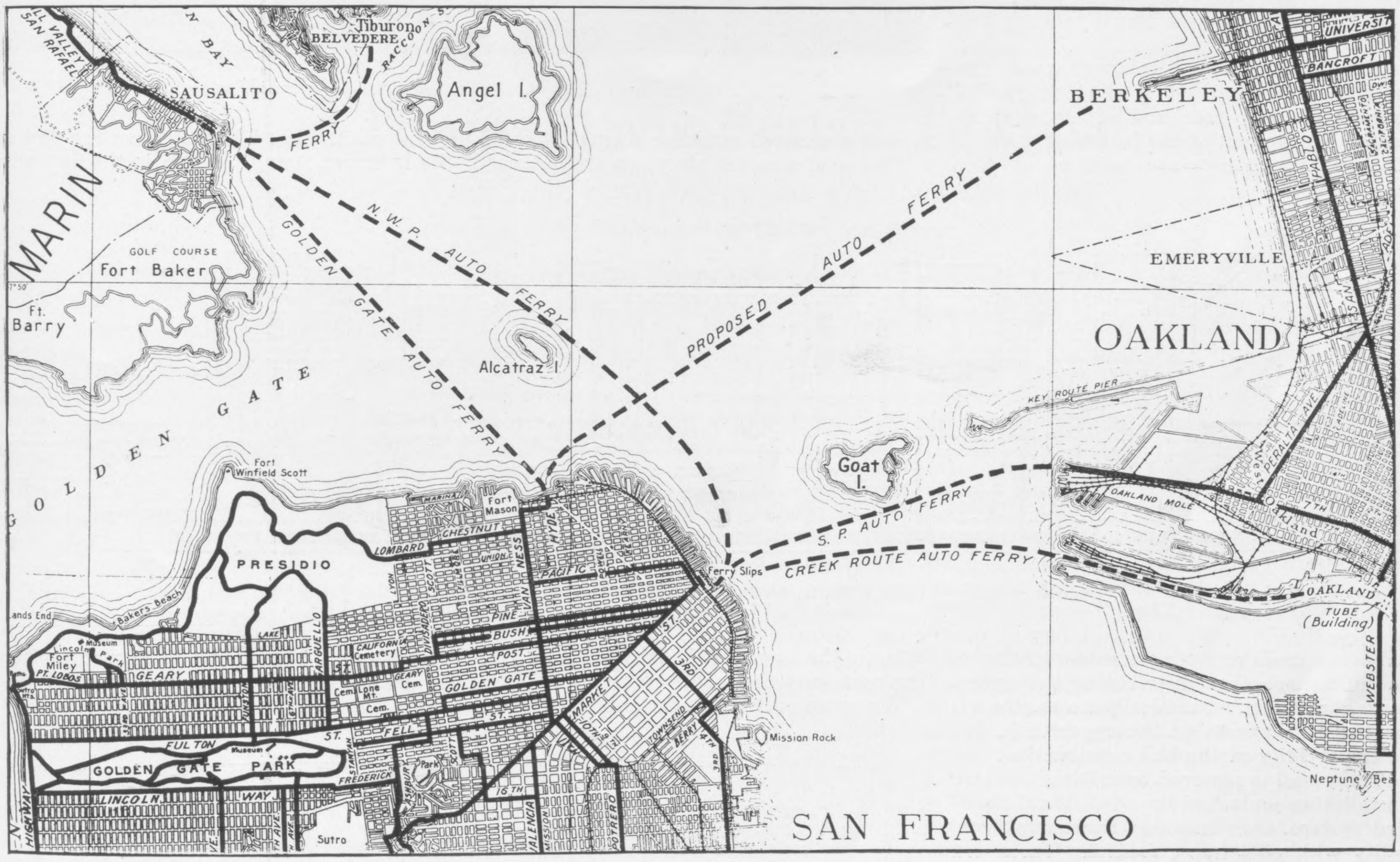
Golden Gate Ferry Company Adds New Ship to Fleet and Southern Pacific Plans Five

FERRY services on San Francisco Bay will shortly be augmented by 6 large and powerful Diesel-electric vessels capable of handling automobile traffic as well as ordinary passenger traffic. This is indicative of the interest now being shown in this form of propulsion for vessels operating in large harbors, such as ferryboats and towboats. Of particular interest is the fact that 5 of these 6 vessels will be for the Southern Pacific Railroad, representing that company's first venture in motorships.

Economies effected in the operation of the new ferries will be used on the Oakland run and two on the Northwestern Pacific run.

At the present time a 15 minute schedule is maintained on the Oakland run and about 20 minutes is required to make the passage from San Francisco to Oakland. It is expected that when the new ferries are put in service, that a 10 minute schedule will be in operation, thus relieving the great congestion now existing between San Francisco and Alameda counties. The Northwestern Pacific run is greatly in need of framing. The sides of the superstructure, housing the automobiles, are to be built of steel with bulb angle frames. The enclosure will be light and ventilated by large steel frame windows on each side and will be clear space from casings to side of enclosure. The hull will be subdivided into 8 watertight compartments, making the vessel safe in case of any compartment being flooded.

The engine bedplates are to be bolted directly to plates riveted to reverse bars and intercostals and side keelsons are to



Auto-ferry routes in San Francisco harbour are served by Diesel-electric ferries on important transportation lines

motor ferries GOLDEN GATE and GOLDEN WEST, fostered the construction of a third motor ferry, GOLDEN STATE which has just been added to the fleet of the Golden Gate Ferry Company. This Company contemplates building 2 additional ferries of the same type in the very near future. These ferries are constructed of wood and have the Diesel-electric system of propulsion in conjunction with pilot house control.

The five proposed Southern Pacific Diesel ferries, preliminary particulars and drawings of which were published in July MOTORSHIP, are to be operated on two individual routes, one from San Francisco to Oakland pier on the Southern Pacific automobile ferry route, a distance of approximately 3.6 miles, and the other over the Northwestern Pacific from San Francisco to Sausalito, a distance of approximately 6.75 miles. In all probability three of the additional automobile ferries during week ends and holidays and two new boats would greatly expedite automobile travel between San Francisco and Marin Counties. The average time required to cover the route one way is 35 minutes.

As this is the first venture on the part of the Southern Pacific Company in Diesel motor ferries, an exact comparison of fuel consumption of Diesel with steam, is not available but it is estimated that a saving of approximately \$4.35 to \$5.40 per hour, will be effected by the use of Diesel electric drive. A saving of \$5.00 per hour would mean \$80.00 saving in fuel in a 16 hour day.

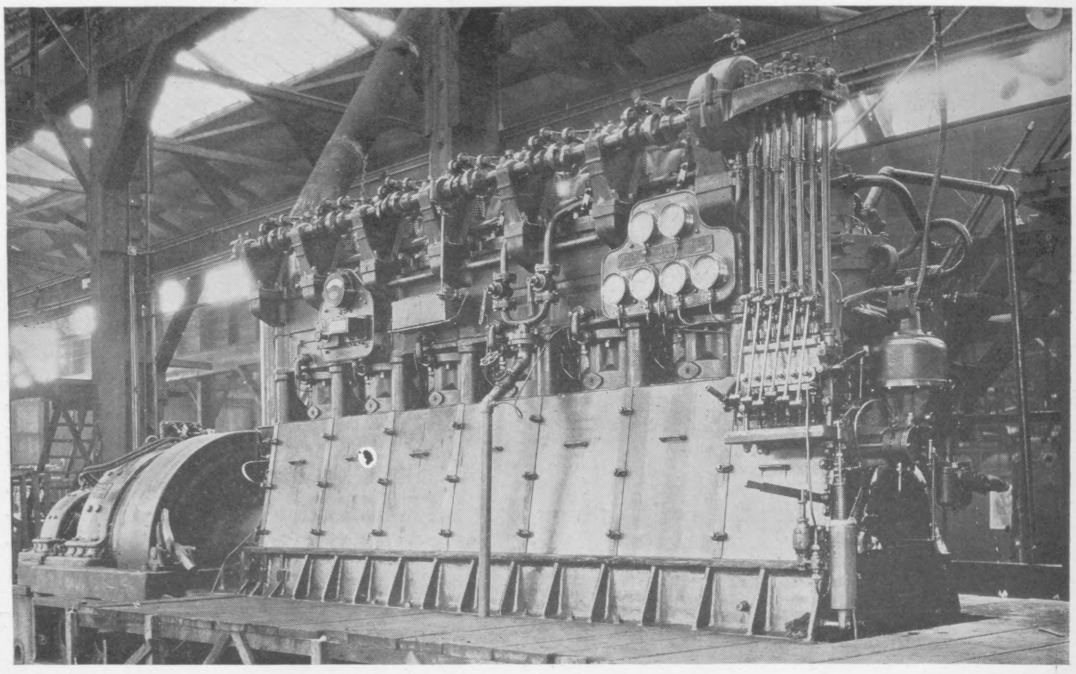
The specifications submitted to the shipyards for bids call for vessels of steel construction throughout. The hull of the vessel up to the main deck is to be built entirely of steel on the transverse system of form girders under the holding down bolts.

Propulsion machinery for each ferry, is to consist of four 400 b.hp. vertical type Diesel engines of not less than 200 r.p.m. or over 320 r.p.m., direct connected to 275 kw. d.c. generators and 25 kw. exciters. These generators are to supply power to two double armature motors of 1250 hp. each, 100 to 130 r.p.m. at 500 volts.

Ward-Leonard control system is to be provided for double pilot house and one engine room control station. The exciters are to furnish all power for operating auxiliaries and electric lighting but not the fire pump, located on the main deck or the emergency air compressor.

A 70 hp., 1500 r.p.m. gas engine is to drive a direct connected 25 kw., 125 volt generator on one end and on the opposite end a centrifugal fire pump, through a clutch.

The heavy automobile traffic demands additional ferry service immediately and it is believed that the new ferries will be constructed as soon as possible, to alleviate the congested traffic conditions. It is estimated that the first ferry will be completed in about eight months from the signing of the contract and one boat delivered every 30 days thereafter.



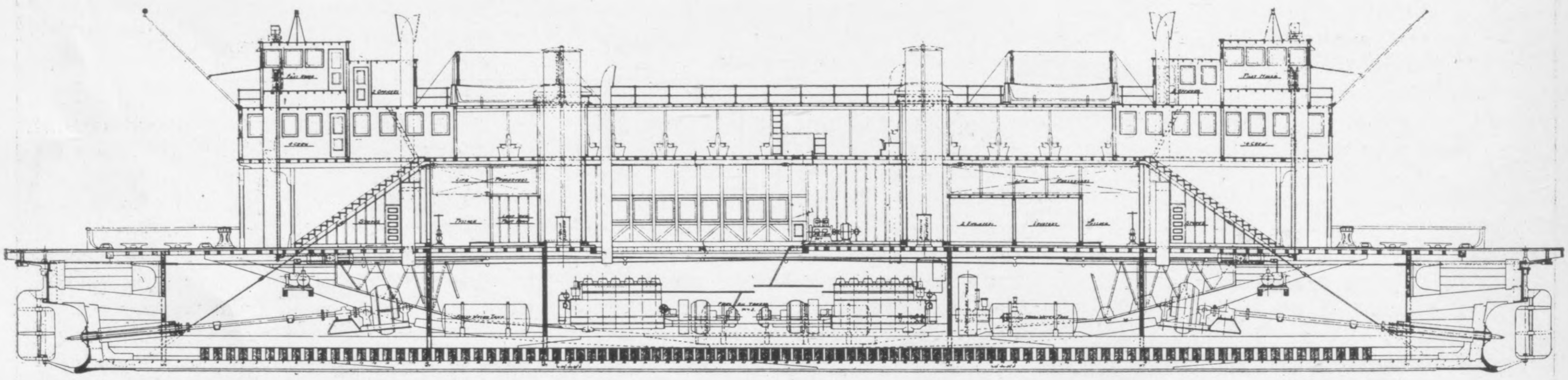
Golden State has three 270 kw. Diesel generator sets

Characteristics of Golden State

Length, overall	240 ft. 9 in.
Beam, moulded	44 ft. 0 in.
Beam, over guards	60 ft. 0 in.
Depth at center	17 ft. 0 in.
Capacity of automobiles	80

The motor ferry GOLDEN STATE was built in the Alameda yards of the General Engineering & Drydock Company of San Francisco and was turned over to the owners on July 2nd. The engines had never been given a shop trial and only a few Bay trials were made before placing the vessel on a constant schedule between San Francisco and Sausalito.

Hull and superstructure are of wood. The hull is reinforced by 2 steel fabricated trusses running fore and aft to approximately 70 per cent of the length of the hull. The engine seatings are built up of deep timbers extending over a considerable number of frames, thus distributing the engine load generously. Practically no engine vibration is apparent on the upper deck, due to the rigidity of the hull construction.



Outline profile of Golden State, Golden Gate Ferry Co.'s new Diesel-electric ferry

The vessel is powered by a Diesel-electric installation controlled by a full Ward-Leonard system, thus insuring maximum flexibility with pilot house control. Three 400 hp. Pacific-Werkspoor Diesel engines drive 270 kw. General Electric generators and 30 kw. exciters direct connected to the main units. The Diesels have 6 cylinders 13 3/16 in. diameter by 19⅝ in. stroke and run normally at 265 r.p.m.

The ferry is of double ended type and the 2 propellers are driven by attached motors of 900 hp., 750 volts and 150-180 r.p.m.

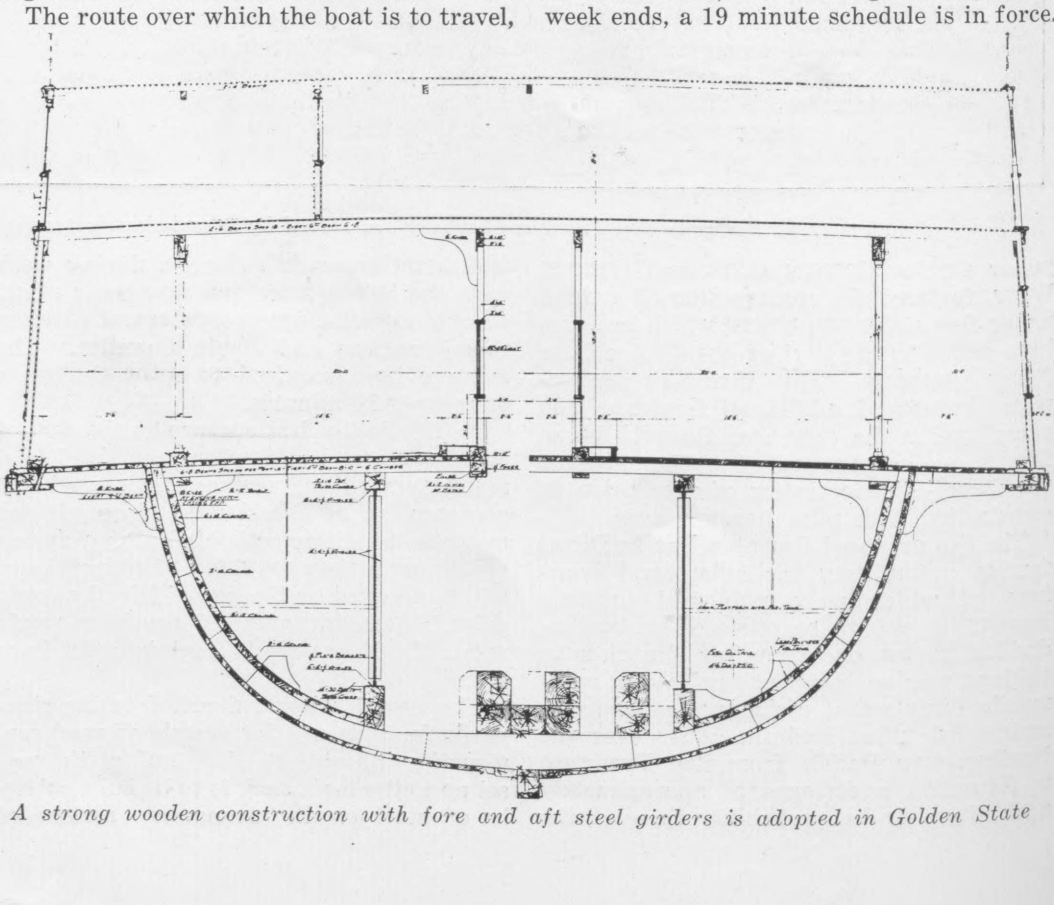
All auxiliaries are Westinghouse motor driven fitted with magnetic control panels.

The main deck is arranged to accommodate 80 average sized automobiles and only a very narrow portion of the center section of the deck, is occupied by engine casing, paint locker and stacks.

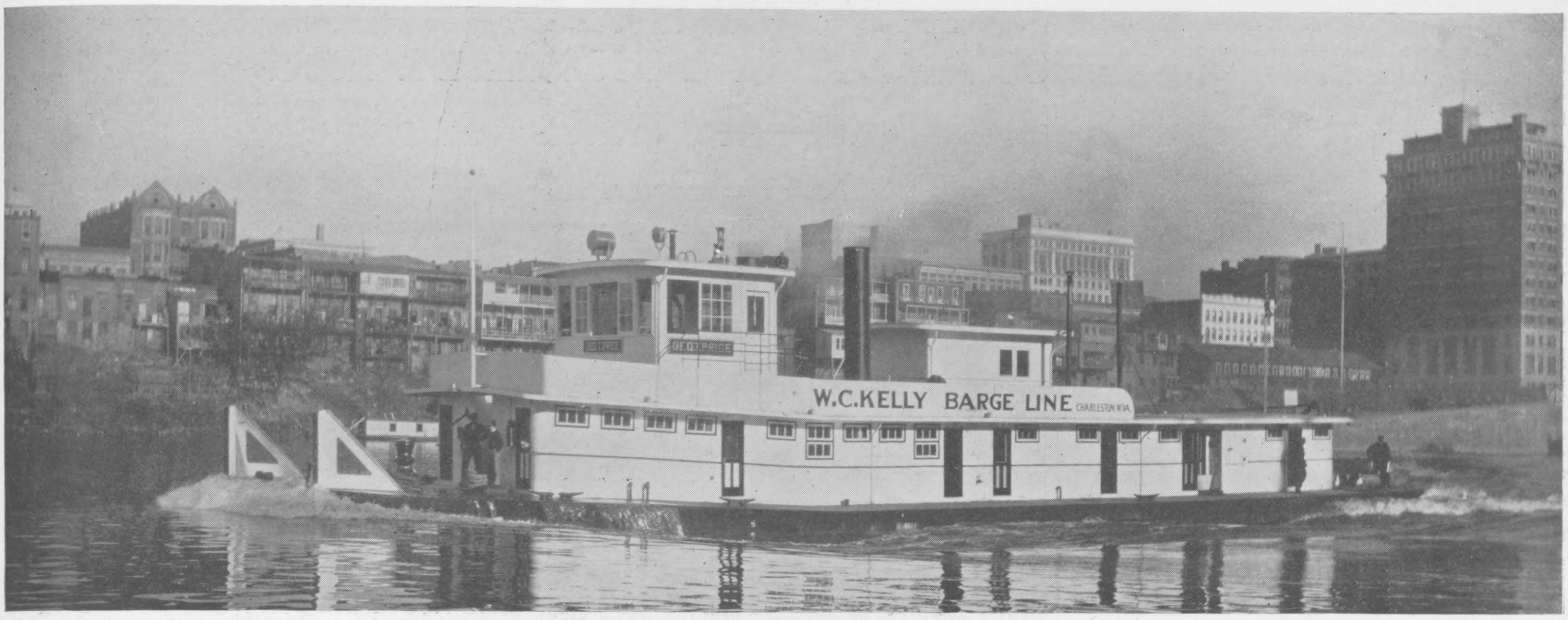
The upper deck is provided with a galley, located between two dining rooms together capable of seating 76 persons. Opposite one of the dining rooms, is a ladies' rest room with wicker lounging furniture upholstered in rose color to match the window draperies. Opposite the other dining room a well appointed smoking room is located.

The lavatories are placed on the outboard side on the upper deck between the smoking room and the ladies' rest room.

The route over which the boat is to travel, is approximately 4.6 miles from the foot of Hyde Street, San Francisco, to the Sausalito waterfront. Normally a 30 minute schedule is maintained, but during holidays and week ends, a 19 minute schedule is in force.



A strong wooden construction with fore and aft steel girders is adopted in Golden State



Western River Towboat Geo. T. Price, powered with 720 s.hp. direct-connected Diesels, handles 6 barges of 3876 tons collective capacity

Semi-Tunnel Twin-Screw Towboat

W. C. Kelly Barge Line Starts Operations with Tug Driven by 720 s.hp. Direct-connected Diesel Engines

By Geo. Szepinski.

THAT a general revival of the old time activity on our inland waterways is not far away is the consensus of opinion concerning river transportation. More than likely, however, the old time activity will not be brought about by using the old time equipment, because in order to satisfy the ever present demand for increase in efficiency and decrease in cost, the application of the Diesel engine power as the most efficient means of propulsion will play a very important role in the modern floating equipment used in river transportation.

The surprisingly large number of inquiries received by inland shipbuilders from prospective shipping concerns during the last 18 months demonstrates a marked tendency to give careful consideration to the latest developments in this field. These inquiries are also indicative of the splendid possibilities in river transportation due to two things: the increased earning power of the internal combustion engine as compared with steam power and the assurance of a 9 ft. river stage from Pittsburgh to Cairo in about three years from now.

The advantages in fuel economy of the Diesel engine over the high-pressure, long-stroke, non-condensing steam engine used on Western river-boats are obvious, the substantial increase in earning capacity forming the main attraction of the Diesel installation.

Consideration of the advantages of the screw propeller over the stern-wheel drive, however, is leading to arguments for and against either application and will probably remain in this status unless two boats of equal power, one fitted with screw propellers and the other with stern-wheel drive, are operated over the same stretch of river, furnishing accurate data for comparison of the two principal methods of propulsion.

Allowing an increase of 10 per cent in shaft horsepower to cover the losses in the reduction gear which must be employed to transmit the power of the Diesel engine to the stern-wheel, it is found that no appreciable advantage in pushing power can be claimed for either type of towboat. The curves shown illustrate the pushing power for the screw and stern-wheel boats, based on shaft horsepower and the required shaft horsepower for both types of towboats at varying speed.

Owing to the almost negligible difference in pushing power it would seem merely a matter of choice which type of boat to select for a Western river towboat, were it not for the superior handling qualities of the screw propeller boat. This feature and also the elimination of a gear drive has in no small measure influenced the W. C. Kelly Barge Line, a recently formed company, in the selection of the type of towboat for the first unit of its fleet, namely the propeller vessel GEORGE T. PRICE, designed by The Charles Ward Engineering Company and built at its works at Charleston, W. Va.

This vessel is 126 ft. in length, has a beam of 26 ft. and a molded depth of 7 ft. She is designed to have a constant draft at the stern in order to provide a fixed water seal for the tunnel, regardless of the amount of fuel in the tanks, and the change in trim due to any variation in the amount of fuel oil is at the stem only. The draft with 20,000 gal. of fuel oil and 7 tons of fresh water on board is 5 ft. 1 in. amidships.

The hull of this towboat is unusually heavy for a Western river craft, all shell plates being 3/8 in. thick, increased to 7/16 in. at the bow and along the bilge of the forward rake. Transverse framing is used almost entirely, the frames being 3½ in. x 3 in. x 5/16 in. angles, with the exception of the after portions forming the after rake and of the bottom in way of the tunnels, which is longitudinally framed, using 3 in. x 5 in. x 5/16 in. angles. Four water-tight bulkheads, built up of ¼ in. plating with angle stiffeners 3 in. x 2½ in. x ¼ in. and two longitudinal oil-tight tank bulkheads divide the vessel into six compartments.

The compartment aft of the fore peak is fitted with a wooden floor and is accessible through a large hatch from the main deck. It is intended for stowing provisions, etc., in bulk for long runs. The capstan machinery is located at the forward end of this compartment, and two air tanks and two fresh water tanks are placed between the oil tanks which extend forward of bulkhead No. 45 into this compartment. The intakes for the engine cooling water service are in this space, the cold well being located about amidships in line with the sea chests. From the cold well a suction pipe leads aft to the engine room.

The engines are placed on very heavy foundations in the pit between the longitudinal fuel oil tanks. The auxiliary air compressor and the fire and bilge pumps are on the same level with the main engines, but the generators and the fresh water and river water pumps are on the main deck level.

The compartment aft of the engine room contains two fresh water tanks and four air tanks. In the last compartment, which reaches from bulkhead No. 20 to the after transoms, the steering mechanism is located.

The deckhouse is 18 ft. wide and 107 ft. long, providing room for all quarters for the crew. The messroom, fitted with oak furniture consisting of a large table, 10 chairs, a buffet and a china closet, is at the after end of the house. Forward of the messroom are the galley and the ice box. A swinging door connects the galley with the messroom, but the sleeping quarters forward of the galley are separated from the after part of the deckhouse by

athwartship partitions. The ice box holds 1600 lb. of ice, and the usual small dairy locker, racks and fittings are installed. Drinking water is cooled in special containers located in the ice compartment and from there piped to a drinking fountain in the messroom.

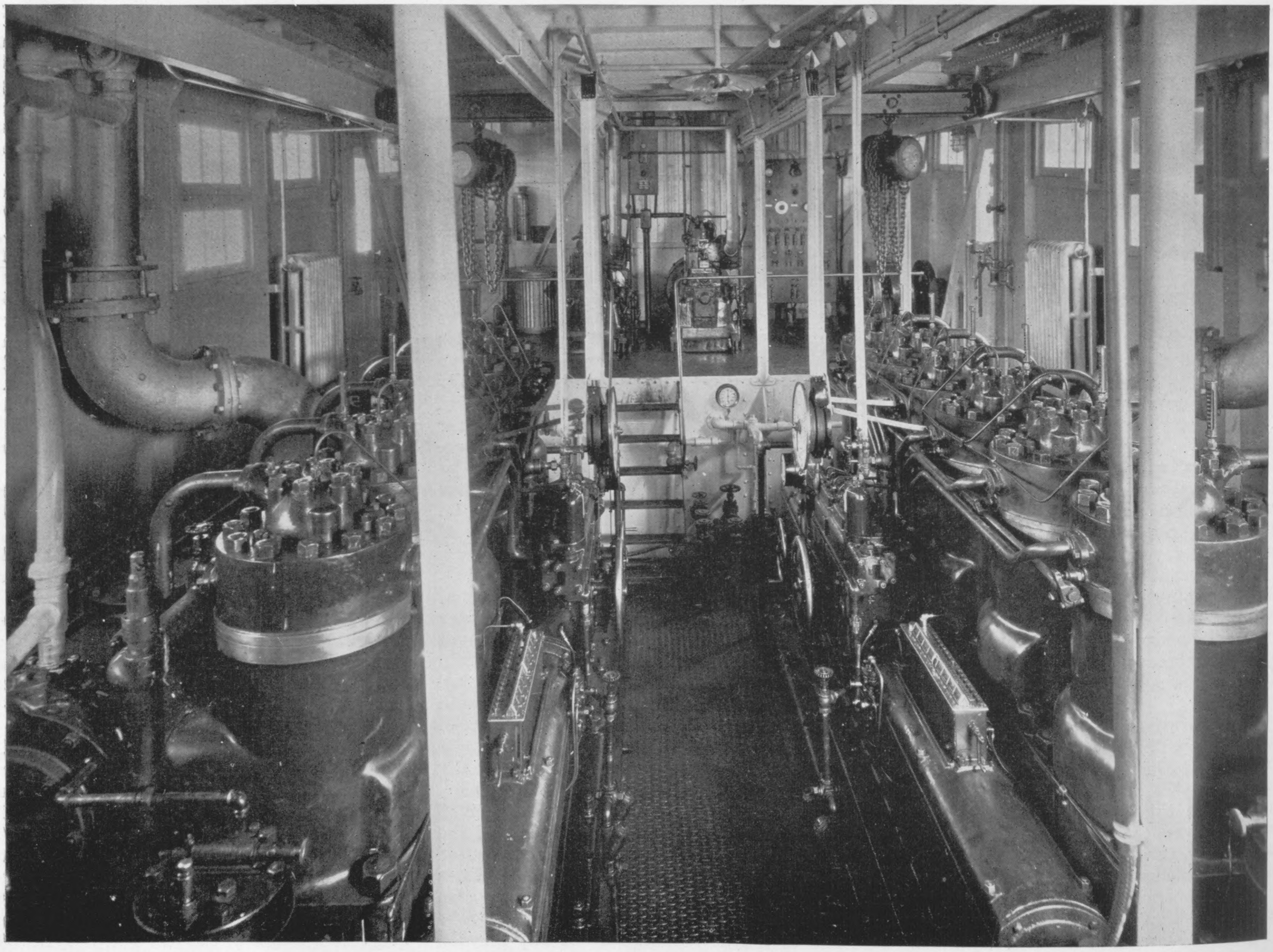
The galley is equipped with a range fitted for oil burning, using the same grade of fuel oil as the main engines, a sink piped for hot and cold water, a kitchen cabinet and ample shelves for pantry service.

The sleeping quarters are all located along a hallway reached from the outside through the laundry. The crew's toilet and shower bath are also reached from the laundry. In the laundry is placed the Arcola heater which furnishes heat to the engine room and to all quarters with the exception of the pilot house, where a Burnside coal stove is installed.

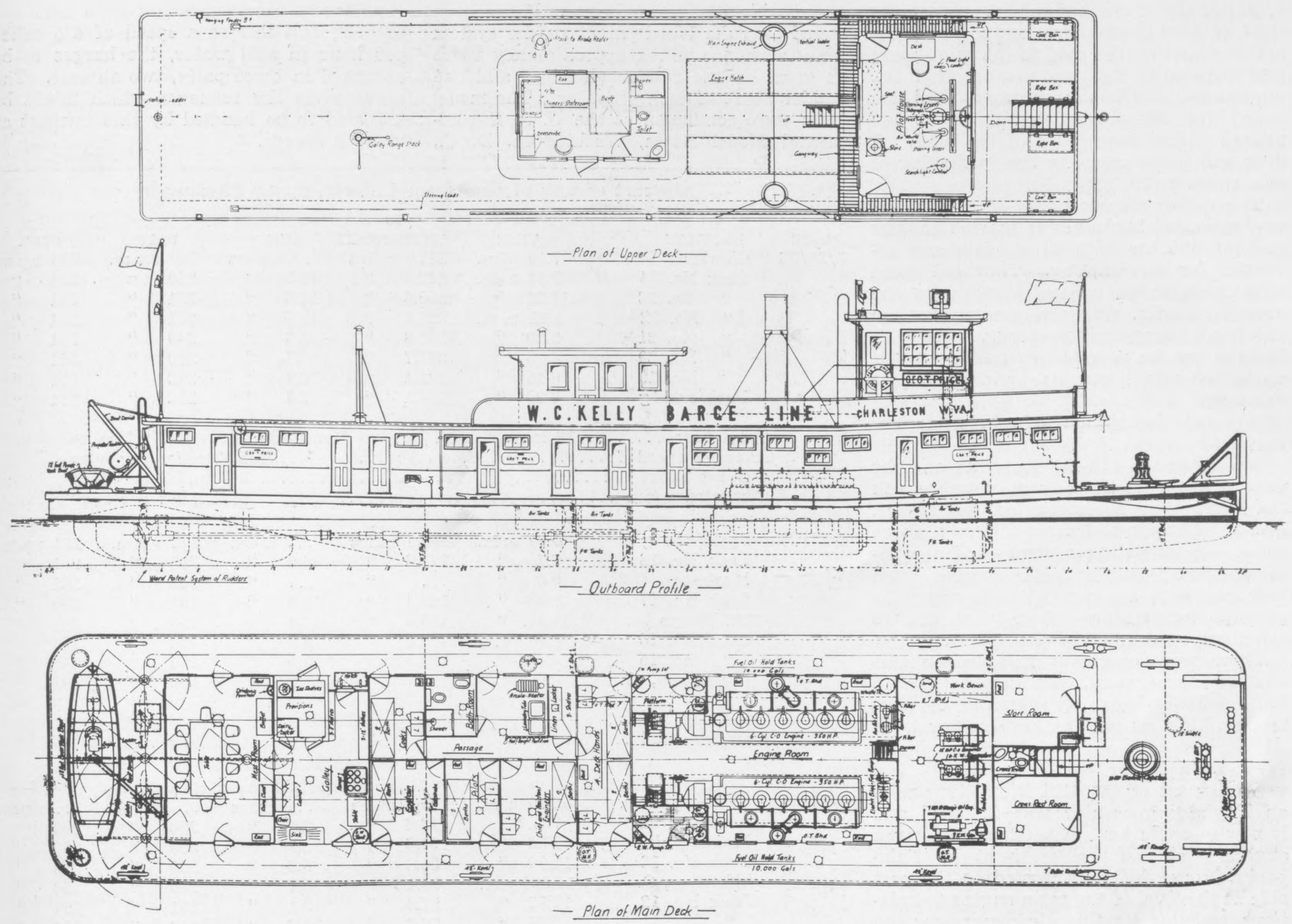
Forward of the engine room, on the port side, is a storeroom for ropes, etc., and on the starboard side, a room to be used by the deck crew in bad weather. A toilet is fitted under the stairs which lead to the upper deck.

The pilot house and the owner's cabin are located on the upper deck. The owner's cabin is a combined sitting room and bed room with a toilet and shower adjoining. The pilot house is very roomy and contains the necessary equipment for handling the vessel. The electrical controls for the steering gear are arranged in such a manner that the manipulation of the levers does not differ in any way from the usual steam handling arrangement. The hand steering wheel is mounted on a drum, and a wire rope connects this drum with the quadrant on the forward rudder. A helm angle indicator is actuated by the rotation

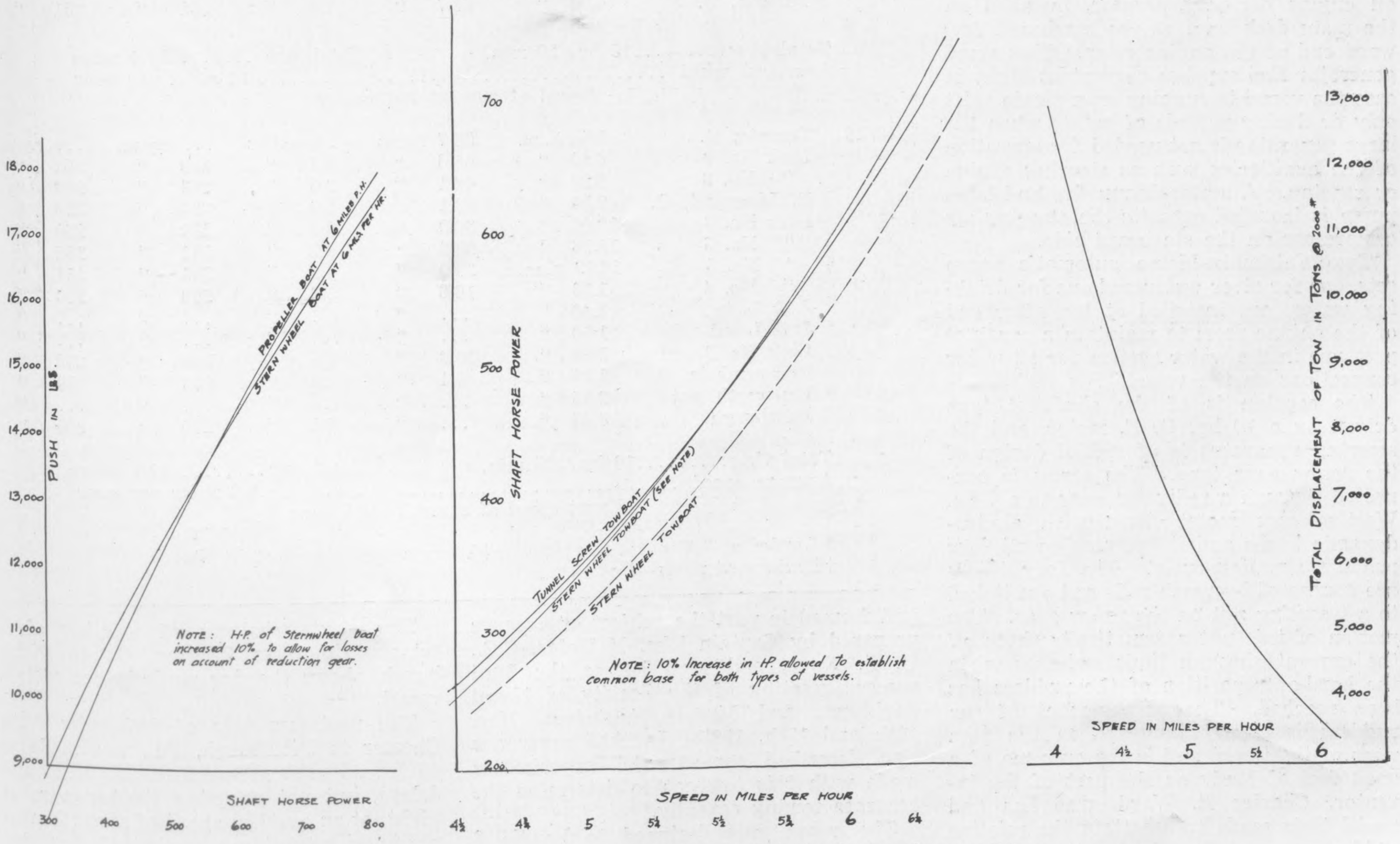
Old time Western River pilot house has modern engine telegraphs and rudder controls



Two 6-cylinder direct-connected Diesels are the main propelling units, arranged in a well ventilated machinery space



Motortug Geo. T. Price has a maximum draft amidships of 5 ft. 1 in.



Performance data of the towboat Geo. T. Price under varying conditions

of the shaft of the handwheel. A searchlight of 8000 candlepower and a flood-light are mounted on the roof of the pilot-house and operated in the usual manner from the pilot-house. The conventional tell-tale board for the navigating lights is arranged within easy reach of the pilot. A desk and settee complete the furnishing of this room.

The power plant consists of two of the new type Fairbanks-Morse marine engines each of 360 hp. with 6 cylinders and arranged for air starting. They are fitted with a clutch to connect directly to the propeller shafts. The reversing mechanism functions very satisfactorily, and the engines can be reversed as quickly as the operating wheel can be handled by the engineer.

A good description of these engines appeared in the February issue of this magazine on pp. 113-118 inclusive, and the only additions made to them, not shown in the illustrations accompanying that article, are a tachometer—located directly above the speed regulating control—and a pyrometer—fitted on the after engine room bulkhead with a gang switch to show the exhaust temperature of each of the 12 cylinders, as wanted by the operator.

There were originally installed on this boat two generators, each driven by a 15 hp. Fairbanks-Morse oil engine of the electric starting, as well as air starting type. At a later date a decision was made in favor of a larger engine, and a 16 kw. generator set of the Hill Diesel type with an Engberg generator was installed and is now in operation. A small motor-driven auxiliary air compressor, built by Fairbanks, Morse & Co., is located on the port side at the level of the main engine foundations, and this starting air compressor can receive its current from a 7 hp. St. Marys oil engine driven generator, installed on the main deck level at the starboard forward end of the engine room. This small generator also supplies current at night in case the vessel is running on a single shift only or during periods of lay-up when the large generator is not needed for operation of the auxiliaries such as steering engine or capstan. A motor-driven fire and bilge pump is installed opposite the starting air compressor on the starboard side.

Two Fairbanks-Morse automatic pump sets, one for river water and one for drinking water, are installed at the after end of the engine room to maintain a constant pressure in the water system for all water connections on the vessel.

The capstan is of the electrical type driven by a 10 hp. G. E. motor, and the steering apparatus is of special design of the screw gear type. The screw is connected through a reduction gear to a 7 hp. Westinghouse motor fitted with electrodynamic brake and it operates on all four rudders simultaneously. The four tillers are connected by reach rods and are linked to a traveling nut on the screw gear. The motion of this nut automatically shuts off the current through limit switches when the hard-over position of the rudders has been reached. The arrangement of the rudders is clearly indicated in the plan view of the vessel and is the outcome of a good deal of study on the part of the inventor, Charles E. Ward, who has had model tests made to ascertain the relative rudder power of the Ward system as compared with others now in use. It has been found that the Ward patent rudder system gives a rudder power approximately twice as great as one rudder ahead of and one rudder abaft of each propeller. The model tests were conducted at the U. S. Experimental Model Basin, Washington, D. C., and formed in part the subject of a paper prepared by Captain Wm. McEntee, C.C., U. S. Navy, and read before the 33rd general meeting of the Society of Naval Architects and Marine Engineers, Nov. 12th and 13th, 1925. In that paper are also described some model experiments made with this towboat to determine the accurate towing capacity.

The vessel was designed to handle 6 barges, representing a total displacement, inclusive of the towboat, of 3876 tons and to push this tow at a speed of $6\frac{1}{4}$ miles per hour in still water, the barges to be arranged in three pairs, two abreast. The curve gives the tonnages which might be expected to be handled by this towboat at varying speeds.

Abstract of Log of Run from Chester, O., to Pittsburgh

DATE	LOCATION	TIME	TO PITTSBURGH	RUN	PORT	STBD.
3/24/26	Chester	7.10 a. m.	257 miles	... miles	249 r.p.m.	252 r.p.m.
	Lock No. 24	9.33 a. m.	242 "	15.0 "	250 "	254 "
	" No. 23	11.21 "	230.6 "	11.6 "	251 "	251 "
	" No. 22	1.11 p. m.	220.1 "	10.5 "	251 "	251 "
	" No. 21	2.20 "	213.8 "	6.3 "	249 "	251 "
	" No. 20	4.25 "	201.7 "	12.1 "	250 "	251 "
	" No. 19	6.15 "	191.4 "	10.3 "	252 "	251 "
	Parkersburg	7.30 "	184.1 "	7.3 "	252 "	251 "

Total time..........12 hr. 20 min. Total run..........72.9 miles
Average speed ....5.92 miles per hour
Current about ....3.8 miles per hour
Corrected speed ....9.72 miles per hour

DATE	LOCATION	TIME	TO PITTSBURGH	RUN	PORT	STBD.
3/26/26	Parkersburg	6.15 a. m.	184.1 miles	... miles	252 r.p.m.	251 r.p.m.
	Lock No. 18	7.7 "	179.3 "	4.8 "	251 "	251 "
	Marietta	9.0 "	... "	... "	252 "	251 "
	Lock No. 17	9.40 "	167.4 "	11.9 "	251 "	250 "
	St. Marys	11.47 "	155.0 "	12.4 "	250 "	251 "
	Lock No. 16	1.20 p. m.	146.4 "	8.6 "	250 "	251 "
	" No. 15	4.20 "	128.9 "	17.5 "	250 "	251 "
	Clarington, O.	6.20 "	117.7 "	11.2 "	250 "	251 "

Total time..........12 hr. 05 min. Total run..........66.4 miles
Average speed ....5.5 miles per hour
Exact speed of current not known

DATE	LOCATION	TIME	TO PITTSBURGH	RUN	PORT	STBD.
3/27/26	Clarington, O.	6.30 a. m.	117.7 miles	... miles	... r.p.m.	... r.p.m.
	Lock No. 14	7.14* "	113.8 "	3.9 "	250 "	250 "
	Moundsville	10.2 "	101.6 "	12.2 "	250 "	250 "
	Lock No. 13	11.00 "	95.8 "	5.8 "	250 "	250 "
	Wheeling, O.	12.00† p.m.	90.1 "	5.7 "	250 "	250 "
	Lock No. 12	12.52 "	87.0 "	3.1 "	251 "	251 "
	" No. 11	2.45 "	76.3 "	10.7 "	250 "	253 "
	" No. 10	4.43 "	65.7 "	10.6 "	252 "	251 "
	Toronto, O.	6.00 "	58.7 "	7.0 "	251 "	251 "

Total time..........10 hr 39 min. Total run..........59.0 miles
Averaged speed ....5.14 miles per hour
Speed of current not known

DATE	LOCATION	TIME	TO PITTSBURGH	RUN	PORT	STBD.
3/28/26	Toronto, O.	6.5 a. m.	58.7 miles	... miles	... r.p.m.	... r.p.m.
	Lock No. 9	6.40 "	55.6 "	3.1 "	250 "	252 "
	" No. 8	8.20 "	46.1 "	9.5 "	250 "	250 "
	E. Liverpool, O.	8.50 "	43.1 "	3.0 "	250 "	250 "
	Lock No. 7	10.00 "	36.9 "	6.2 "	250 "	250 "
	" No. 6	11.18 "	28.8 "	8.1 "	251 "	252 "
	" No. 5	12.19 p. m.	23.9 "	4.9 "	250 "	251 "
	" No. 4	1.20 "	18.6 "	5.3 "	250 "	250 "
	J. & L. in	1.40 "	... "	... "	... "	... "
	J. & L out	1.50 "	... "	... "	... "	... "
	Lock No. 3	2.50 "	10.9 "	7.7 "	250 "	250 "
	Emsworth in	3.30 "	6.1 "	4.8 "	250 "	250 "
	Emsworth out	3.55 "	... "	... "	... "	... "
	Pittsburgh	4.45 "	... "	6.1 "	250 "	250 "

Total time..........10 hr. 05 min. Total run..........58.7 miles
Average speed ....5.8 miles per hour
Exact speed of current not known

* Landed at 7.18 a. m. on account of heavy snowstorm—lost 36 min.
† Exchanged pilots—lost 15 min.

The above abstract of the log of a recent trip from Chester, O., to Pittsburgh, shows the fine performance of this vessel.

The upstream trip of 257 miles from Chester to Pittsburgh, Pa., was made in 46 hr. 35 min. gross, including locks and delays, but not counting the lay-overs at night, at an average speed of about 9 miles per hour, assuming a current of about $3\frac{1}{2}$ miles per hour.

Italian Ms. Fella Now in Pacific Trade

Supercharging and Contra-propeller Add 1½ Knots to Speed on Her Maiden Voyage

THE new motorship FELLA of the Navigazione Libera-Triestina line of Trieste visited the Pacific Coast of America in June, coming as far north as Vancouver, B. C., on her maiden voyage from Italian ports via Panama Canal. She is the second of 4 new motorships of this line for the Mediterranean-Pacific Coast service, the first being the LEME described in February, 1926, MOTORSHIP.

The general arrangement of FELLA is much the same as LEME, though she has a slightly smaller hull and different engines. Her principal dimensions are, length b.p. 480 ft. by 56 ft. beam and 38.2 ft. depth molded. She has a displacement of 14,000 tons and about 10,000 tons d.w. cargo capacity and accommodation is provided for 25 passengers.

Both hull and engines were built by Stabilimento Technico Triestino at Trieste, and the ship was commissioned late in 1925. The main propelling engine is of Burmeister & Wain type. It is a 6-cylinder unit rated for 4,000 i.hp. at 110 r.p.m., but capable of being speeded up to 125 r.p.m. by supercharging. FELLA has a 4 blade wheel, and there is also a contra-propeller, the vanes of which are fixed on the rudder post.

There are three 2-cylinder 120 hp. B & W auxiliary engines direct connected to generators which supply electric power for pumps, and other engine room auxiliaries at sea, as well as to the supercharging turbo blowers; and also for steering and refrigerating. One of the three sets is sufficient at sea except when the supercharger is being used, when two of the sets are required. Power is provided in port for electric winches and windlass. The auxiliary Diesel engines have large capacity compressors which can be used to build up pressure of starting and injection air in the main engine air reservoirs.

Chief Engineer F. Tognoli says that FELLA averaged 13 knots on the outward trip with a light cargo, and under favorable weather conditions on a fuel consumption of 11 tons a day. The supercharger was not used as the ship was running well within her schedule. The best day's run was at an average of 14.2 knots.

He also states that when the ship ran her trials, she was first tried without contra-propeller or supercharger, and afterwards with these aids, showing quite a remarkable difference. The results were as follow:

Without contra propeller or supercharging	12.5 knots
With contra propeller but no supercharging	13.8 knots
With contra propeller and supercharging	15 knots

The normal r.p.m. without supercharging is 110 and with supercharging 125. The supercharging equipment consists of a turbo blower, driven by a 100 hp. electric motor, which discharges into the large intake manifold extending the full length of the engine, the ordinary air intake opening in this manifold being closed when the supercharger is put in operation. The air pressure is increased by supercharging 1/20 of an atmosphere or 0.7 lb. per square inch over the normal atmospheric pressure.

A Lux-Rich fire fighting system is fitted, the supply cylinders being located in the upper part of the engine room, with pipes extended to every part of the ship, so that the gas can be turned on from the central position to reach any compartment that a fire might start in.

Mr. Tognoli is enthusiastic over the performance of the engines and says that the valves inspected have been in first class condition, and no replacements have been necessary. After being in steam for a number of years he took an examination for a Diesel ticket. The only objection he has to the change is that he finds the auxiliary Diesels rather noisy.

FELLA is being operated on a schedule of a round trip from Italian to Pacific ports every five months, including a month layover at Trieste.

The service is subsidized by the Italian Government. Outward she calls at Mediterranean ports, Havana, Panama Canal and Pacific Coast ports, and returning completes the trip by going direct from Panama to the Mediterranean.

Nordberg to Build Fiat Marine Diesels

Types and Powers for All Marine Requirements to Be Constructed at Milwaukee

ENTRY of another Diesel engine builder in the marine field is made in the announcement that the Nordberg Mfg. Company of Milwaukee has secured the American license for the building of Diesels according to the design of Fiat Stabilimento Grandi Motori of Turin, Italy. Building Diesel engines is by no means a new venture for Nordberg, neither is the building of prime movers for marine service. Heretofore Nordberg have centered their efforts on building Diesels for stationary service in which they have been eminently successful. In addition, a large number of marine steam engines were also built for the United States Shipping Board and for private interests during the war.

The first Nordberg Diesel was built in 1915, a unit of 1250 hp., the largest built in this country up until that time. Since then 41 engines of this one design alone have been built, most of them of the 1250 hp. size. A few years later Nordberg commenced building engines of 2250 hp., 9 of which have now been built or are under construction. These held the record for size of Diesels built in this country until 1925, when Nordberg was awarded a contract from the Panama Canal to build three 3750 hp. engines for service at the Canal.

Successful as Nordberg has been in the stationary field, so Fiat has been in the marine field. Fiat has engines totalling 230,000 hp. in service, practically all of which have been installed aboard ship. There are now 65,000 hp. under construction in the plant at Turin, orders for 20,000 hp. of which were secured in the first four months of 1926. Fiat has been responsible for the machinery installations of some of the most successful motorships in the Italian merchant marine. A recent contract of interest is that awarded by United Fruit Co. for new Diesels on LA PLAYA.

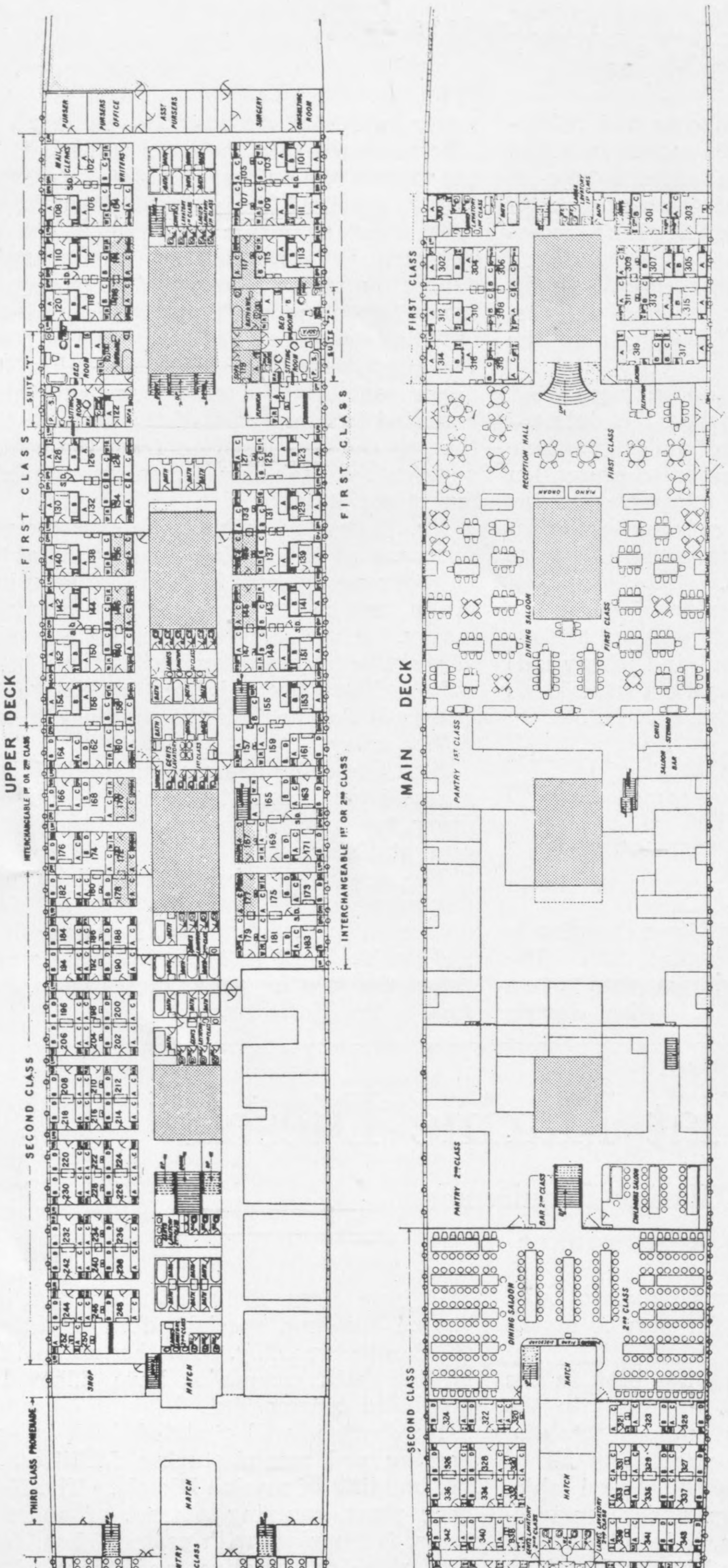
By securing the Fiat manufacturing rights, Nordberg is able to offer to the marine trade engines of known design that have been tried and have proved successful in this exacting service. These engines include both the heavy duty and high speed types, many of the latter having rendered excellent service in submarines and locomotives. Submarine Diesels have been built for 9 different countries.

It is a significant fact that both companies have from their inception of Diesel engine building, specialized in engines of the 2-cycle type only. Another notable fact is that both companies have adhered to crosshead construction.

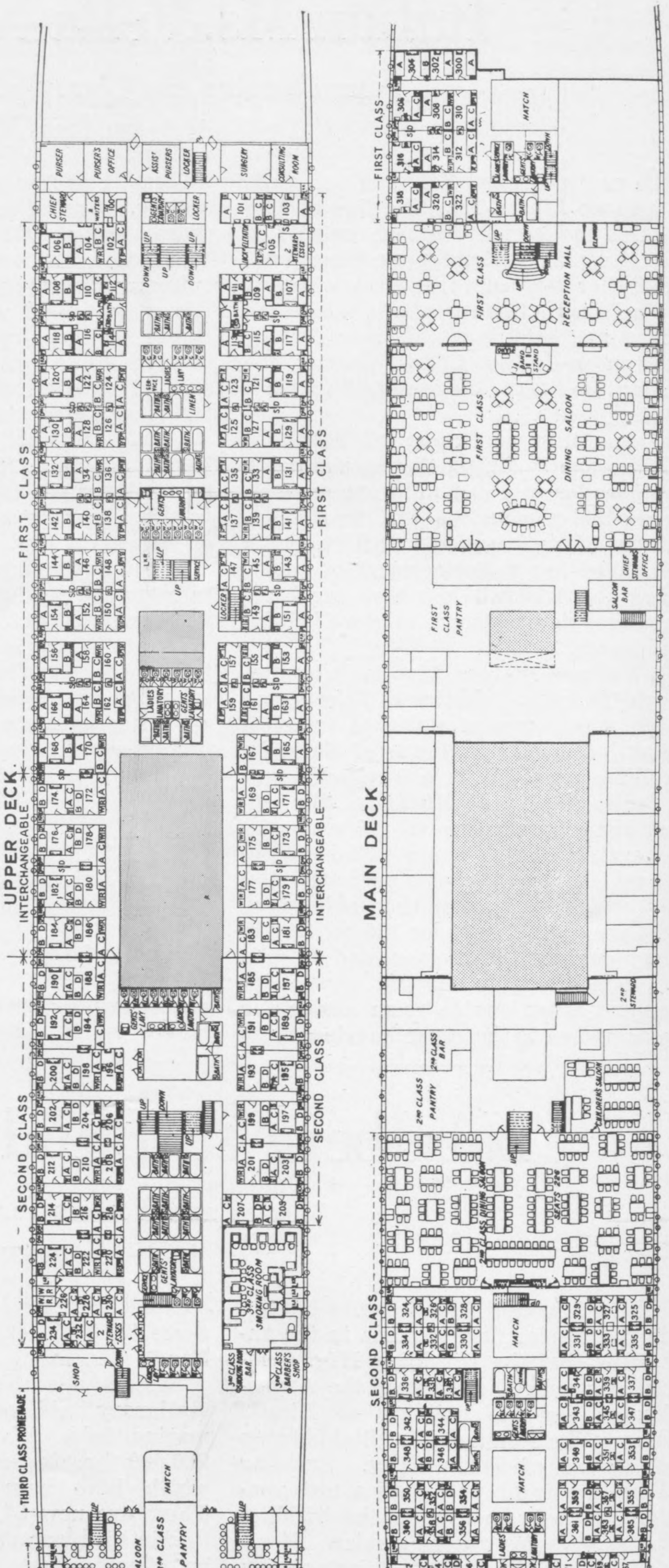
Nordberg is well qualified, both in engineering and manufacturing facilities, for the building of marine Diesels. The Nordberg plant, covering a tract of about 38 acres, is complete with pattern shop, foundry, machine, erecting and forge. It is equipped with the latest type of machine tools and foundry and material handling equipment.

Nordberg has always specialized in the building of high grade power machinery in the larger capacities. The addition of marine Diesels to the Nordberg line is in keeping with the other products now being built.

Through service for freight between Antwerp, Belgium and Detroit, Chicago, Cleveland and Hamilton via the St. Lawrence River and Welland Canal, without transshipment started by the Frank Lane Line and Great Lakes Line has been discontinued after one departure in each direction.



Boiler uptakes absorb much valuable space in this steamer, particularly in dining saloons and public spaces, while cabins are affected by the hot casings



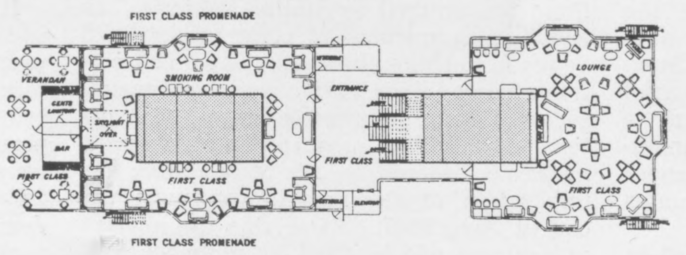
One large machinery casing leaves a clear dining space on the motorliner Carnarvon Castle, while the cabins are unaffected by the heat of the boiler

Big Diesels Improve Passenger Spaces

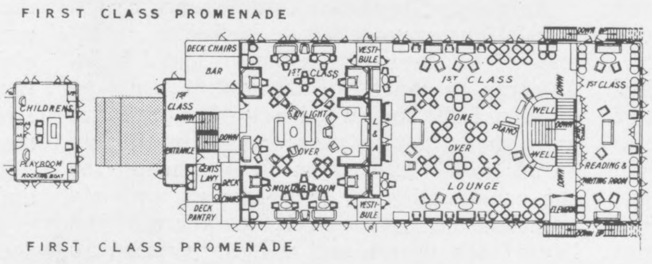
Carnarvon Castle, New 20,000 Ton Passenger Motorliner Has Larger Public Rooms Than Steamer Prototype

THAT the passenger motorliner permits of a superiority of accommodation arrangement over the corresponding steamer as well as giving a greater degree of comfort to passengers occupying inside cabins is well demonstrated in the deck arrangement plans of the two ships which we show on the opposite page. These plans respectively are of CARNARVON CASTLE 20,000 gross tons passenger motorliner built and engined by Harland & Wolff, Ltd., Belfast, for the Union Castle Mail Steamship Co., now on her maiden trip from Southampton, England, to Cape Town via Madeira, and of ARUNDEL CASTLE, a steam driven sister vessel of 19,023 tons gross, which has been operating on this route since 1919. Both ships have a length between perpendiculars of about 630 ft. 0 in., and although one is powered by double-acting cycle engines while the other has geared steam turbines, the power for the sea speed of about 18 knots developed in each ship is in the neighborhood of 20,000 hp. Actually ARUNDEL CASTLE requires slightly more power for the given speed.

CARNARVON CASTLE, the motorliner, has two squat stacks, one of which—the aft one—takes the exhaust of the two main engines as well as of the 4 auxiliary Diesels arranged in a separate engine room forward of the main engine room. These exhaust mufflers and piping are housed in an oblong casing which is run up to the boat deck where the stack is mounted. The forward stack is merely a dummy being mounted on the deck and used as a store for ropes, cargo, clusters, etc. It balances the profile and adds to the vessel's general appearance.



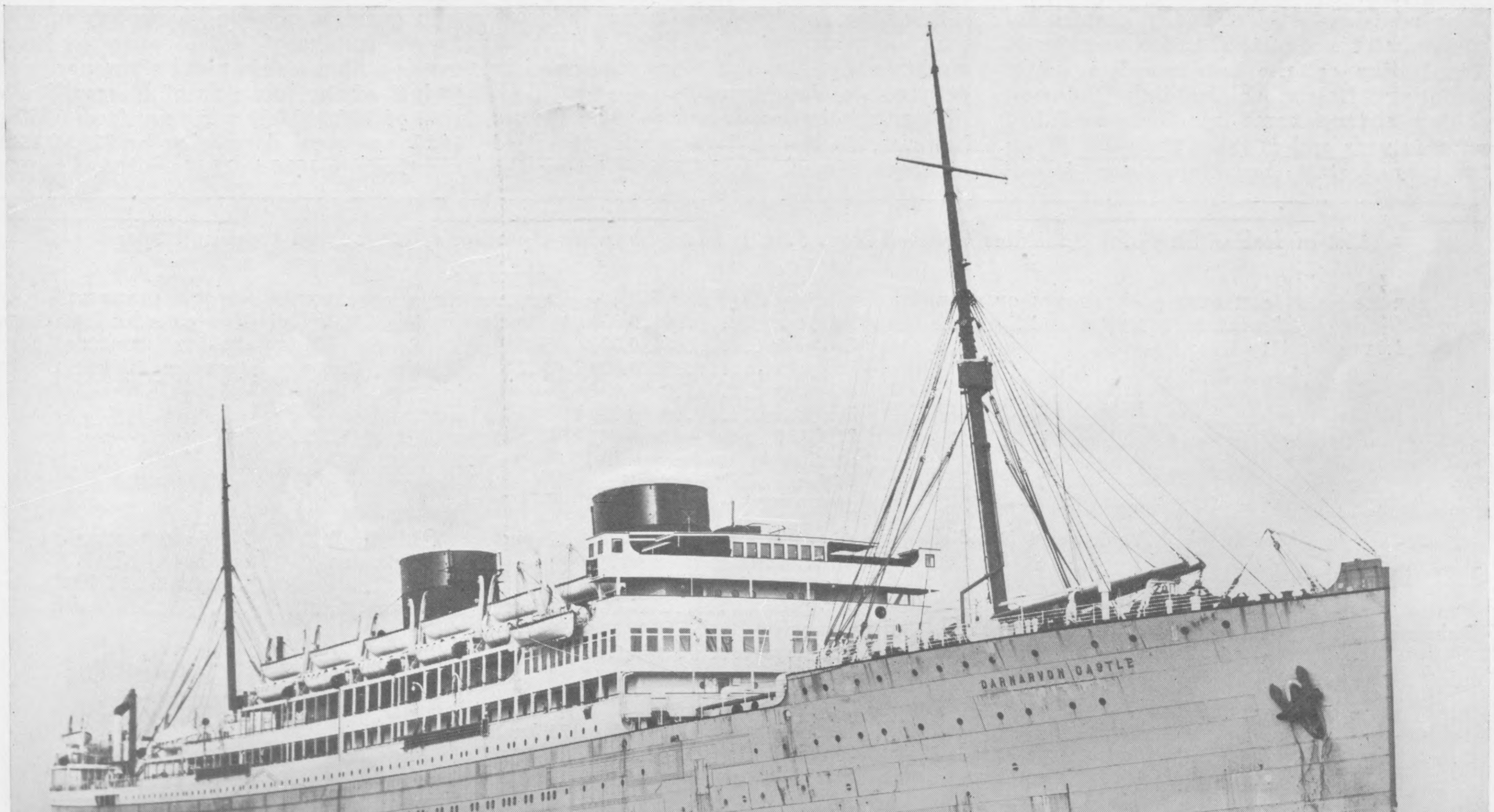
Steamer has obstructed lounge space



Motorliner has clear lounge space

ARUNDEL CASTLE, the steamer, has four graceful flat-oval section stacks, three of which take the hot flue gases from the cylindrical Scotch boilers while the fourth acts as a ventilation to the turbine room. Exactly how these 3 uptakes, which have to be trunked right up to the topmost deck, break into the first-class dining saloon and other public spaces is well shown in the illustration.

CARNARVON CASTLE has an absolutely clear dining saloon space and a clear lounge space on the topmost passenger deck while ARUNDEL CASTLE'S corresponding spaces are broken into by warm—however, carefully lagged—trunked uptakes.



New Motorliner Carnarvon Castle is now on service in the Southampton-Cape route of her owners, Union Castle Co.

Motorships Gain by Shipping Subsidies

Value of Diesel Is Recognized in Italian Government Scheme to Finance Shipping and Shipbuilding Industries

NEW motorship construction, including the building by Lloyd Triestino of a 17 knot motorliner for service between Venice and Brindisi, by the Puglia S. S. Co., of a 15 knot motorliner for service between Venice and Alexandria, as well as of many fast cargo motorships are the direct result of the Italian shipping subsidies which took effect on Jan. 1. Summarized in the table are details of financial aid granted by the Italian Government to shipowners in consideration for the maintenance of the services shown, which cover a great many of the important trade routes of the world.

In addition to the services mentioned in the table which the government has subsidized with a view to assisting the export trade, financial assistance has been given to as many as 28 local passenger and passenger-freight lines operating between Italian domestic ports and to colonies.

The Italian Government has attached particular importance to the employment of motorships in these latter services and as a result orders for a number of small motorliners have been placed. For example, the Florio Steamship Company has ordered 4 ships of 5400 tons each with Tosi engines for the Naples-Palermo run in addition to some smaller ships of from 2000 to 3000 gross tons.

In addition to the subsidies granted for the maintenance of the services mentioned, the Italian cabinet has issued a decree assisting Italy's shipbuilding industry. This assistance came into force on July 1 of this year and it takes the form of exempting certain materials from import duties and also of financial payments to shipbuilding firms. The decree provides for the exemption from import duties of all metal materials required for the hulls of merchant vessels, dredges, tugs, etc. for both sea and river navigation provided these are ordered by Italian subjects. In addition, payment of 27 cents per ton will be made to shipbuilders for plates and sections ordered from Italian works and manufactured from materials exempt from customs duty. This payment only refers to materials ordered by the yards after the publication of the new decree, until the end of June 1927. After this the amount of payment will be fixed by mutual agreement between the Ministry of Communications, Ministry of Finance and Ministry of National Economy.

Builders of towboats complying with the regulations are entitled to receive an assistance of $1.20 per gross ton on metal hulls, 44 cents on concrete hulls and 33 cents on wooden hulls and wooden towboats of not more than 150 tons gross having machinery of 90 hp. These payments are made for the construction of dredges and towboats launched during the first four years of the life of the decree and will be reduced 10 per cent for the next four years, and by 15 per cent for the last five years of the decree.

Subsidies are paid according to gross tonnage, power of machinery, weight of machinery, at the date when the vessel is delivered to the owners.

Upon application from the shipbuilders, however, the Italian Treasury is authorized to grant advances to be made during the ship's construction as follow:

40 per cent to be paid when the vessel is in frame and all main bulkheads are erected.

20 per cent when the vessel is launched.

It is also enacted that all metal materials necessary for the construction of the hull, propelling machinery, parts of propelling machinery and auxiliaries and in general everything required for the construction of pleasure yachts ordered by Italians and aliens, all merchant vessels ordered by foreign shipowners and all warships ordered by foreign governments may be imported free of customs duty. This also applies to similar details for repairs or reconditioning of pleasure craft either Italian or foreign owned, foreign owned merchant vessels and war or other vessels owned by any foreign country. Any special type of machinery may be imported free of customs duty complete for use on Italian merchant vessels, provided this machinery is considered, in the view of the Ministry of Communications, necessary, and if it is not manufactured in Italy.

Appliances necessary to Italian and foreign vessels trading in Italy may also be imported on these concessions. As far as Italian vessels are concerned, they are to be made for only one year after the decree.

In order to provide the money required for the fulfillment of the decree the Treasury is authorized to make allowance in the budget of the Ministry of Mercantile Marine of $22,200,000 per year from 1926 to 1930, and sums decreasing by $111,000 respectively in 1930 to 1934, and 1934 to 1938.

List of Italian Shipping Subsidies Granted from Jan. 1, 1926, Showing Operator's Routes and Required Speeds

SERVICE	SCHEDULE	PORTS OF CALL	SUBSIDY	SPEED REQUIREMENTS	OPERATOR	REMARKS
Genoa-Alexandria	Bi-monthly	Naples and Syracuse	1st year ....$120,000 2nd year ....$110,000 3rd year ....$100,000 4th year ....$ 90,000 5th year ....$ 80,000 $160,000 per annum if service is made weekly, with successive reductions of $10,000 p.a. for 5 years.	17 knots	Soc. Nat. dei Servizi Marittimi, Genoa.	New construction. Geared turbine. Ansaldo, Sestri Ponente. 17 knots.
Trieste-Alexandria	Weekly	Venice and Brindisi	About $200,000 p.a. for mails.	17 knots	Lloyd Triestino	New construction. B & W. engines. Stab. Tech. Triestino. 17 knots.
Venice-Dalmatia	Weekly	Trieste, Pola, Lussinpicolo, Zara, Spalato, Gravosa, Cattaro.	1st year ....$20,000 2nd year ....$12,800 3rd year ....$12,800 4th year ....$10,400 5th year ....$ 9,600	14 knots	Anon. Soc. San Marco.	....
Trieste-Constantinople	Bi-monthly	Venice, Bari, Brindisi, Santi Quaranta, Corfu, Pireo, also Burgas, Sulina, Galatz.	$128,000 p.a. decreasing the following 3 yrs. by $10,000 p.a. each year.	14 knots	Lloyd Triestino	....
Trieste-Black Sea	Bi-monthly	Venice, Fiume, Constantinople, Varna, Constanza, Odessa, Novorrossisk or Constanza, Sulina, Galatz.	— as above —	10 knots	Lloyd Triestino	....
Genoa-Constatinople	Bi-monthly	Leghorn, Naples, Messina, Alexandria, Syrian Coast, Smyrna, Stamboul.	$120,000 p.a. decreasing in the following 3 years by $10,000 p.a. each year.	12 knots	Soc. Naz. Servizi, Marittimi	Similar subsidy for Genoa-Constantinople service on shorter route. Speed 10 knots.

List of Italian Shipping Subsidies Granted from Jan. 1, 1926, Showing Operator's Routes and Required Speeds—*Contd.*

SERVICE	SCHEDULE	PORT OF CALL	SUBSIDY	SPEED REQUIREMENTS	OPERATOR	REMARKS
Venice-Alexandria	Bi-monthly	Trieste, Fiume, Spalato, Bari, Brindisi, Santi Quaranta, Corfu, Patrasso, Calamata, Pireo, Smyrna, Scalanova, Rodi, Adalia, Messina, Alexandretta, Tripoli, Syria, Beyruth, Caifa, Port Said, on outward passage to Alexandria, Candia, Canea, Corfu, Brindisi on homeward passage.	— as above —	10 knots	Puglia S.S. Co.	New construction. Four motorships. B. & W. engines. Stab. Tech. Triestino. 15 knots, 150 pass.
Trieste-Casablanco (Morocco)	Bi-monthly	Venice, Fiume, Catania.	1st year & 2nd year $48,000 3rd, 4th & 5th years, $40,000	10 knots	....	....
Genoa-Congo and Angola	Two monthly	Marseilles, Algiers, Casablanca, Dakar, Konakry, Freetown, Monrovia, Grand Bassan, St. Thome, Port Gentil, Matadi, St. Antonio, S. Philippe de Benguela, Lobito.	$48,000 for 5 years.	11 knots	Nav. Libera Triestina	Service to be operated by the S.S. STELLA, 10 knots. Accommodations for 4 passengers.
Genoa-Concepcion	Monthly	Marseilles, Barcelona, Teneriffe, Barbados, Trinidad, La Guayra, Curacao, Puerto Colombia, Limon, Colon, Guayaquil, Callao, Mollendo, Arica, Iquique, Antofagasta, Valparaiso.	$40,000 p.a. (about)	12 knots	N.G.I.	Service to be operated by motorship CLELIA C. purchased from Tito Campanella & Co. built at Copenhagen in 1912 and fitted with B.&W. engines. Renamed EQUATORE. N.G.I. plans to order for the same service two additional motorships with B.&W. engines.
Genoa-Manaos	Two monthly	Teneriffe, Bahia, Pernambuca, Para.	$36,000 p.a.	11 knots	Cosulich Line	....
Naples-Vancouver	Two monthly	Palermo, Teneriffe, Antille, Panama, San Francisco, Seattle.	$36,000 p.a. during 3 years.	11 knots	Nav. Libera Triestina	Service to be maintained with motorships CELLINA, FELLA, FELTRE and RIALTO.
Genoa-Bombay	Monthly	Leghorn, Naples, Pt. Said, Suez, Aden.	1st & 2nd yrs....$160,000 3rd year ....$144,000 4th year ....$128,000 5th year $110,000	12½ knots	Marittima Italiana	....
Trieste-Bombay	Monthly	Venice, Port Said, Suez, Aden.	— as above —	12 knots	Lloyd Triestino	....
Venice-Calcutta	Monthly	Massowah	1st & 2nd yrs....$40,000 3rd year ....$36,000 4th year ....$32,000 5th year $28,000	10 knots	Soc. Veneziana di Nav. a Vapore.	Motorship MARIN SANUDO under construction for this service. Motorship MAULY chartered from Cosulich Line.
Trieste-Yokohama	Monthly	Venice, Spalato, Brindisi, Port Said, Suez, Massowah, Aden, Colombo, Penang, Singapore, Kobe.	1st & 2nd yrs....$200,000 3rd year ....$152,000 4th year ....$144,000 5th year $136,000	12 knots	Lloyd Triestino	To be maintained by the motorships ROMOLO and REMO.
Genoa-Brisbane	Monthly	Leghorn, Naples, Messina, Catania, Port Said, Colombo, Freemantle, Adelaide, Melbourne, Sydney.	1st year ....$86,400 2nd year ....$96,000 3rd year ....$86,400 4th year ....$76,800 5th year $67,200	12½ knots	Lloyd Sabaudo in conjunction with N.G.I.	Two motorships being built for this service by Cantiere Meirdionali Naples. B.&W. engines 11,000 hp.
Naples-London	Forthnightly	Palermo	1st year $75,000 to be reduced during 2nd, 3rd, 4th & 5th years by $4,000.	12 knots	Adria S.S. Co.	....

Brockville-Morristown Ferry, designed by Eads Johnson, M. E., New York, has a 300 hp. Diesel (See July, 1926, MOTORSHIP)

Correct Temperature Readings Help Engines

Operating Efficiency Will Be Increased and Engine Maintenance Decreased by Accurate Heat Measuring Instruments

By A. B. Newell

WITH combustion and the cooling agent under absolute control, an engine operator may hold his temperatures at an ideal point if only he can get accurate temperature readings. This applies not only to oil engines, where the exact maintenance of ideal conditions of cooling cylinders and pistons and an almost exact control of exhaust gas temperatures contributes much to the overall efficiency, but it applies to all things in which exactness in temperature control is important.

The ordinary thermometers in use today are frail and short lived. They are constantly getting out of order and having to be repaired or replaced—an expensive matter. The upkeep of the thermometers is no laughing matter in so far as expense is concerned.

Exactly what their inaccuracies contribute to the cost of engine upkeep cannot be estimated, but it is great. Before writing this article I asked several engineers why they failed to get accurate temperature readings. One replied: "Well, I can't always leave the maneuvering platform and go to the top of the engine to read the thermometers, and my oiler is a spick that could not tell me what he saw if he could read it." Another said: "I generally do get close readings on the water, but the thermometer wells on the exhaust pipe are burned off half the time and the thermometers are on the blink the rest of the time."

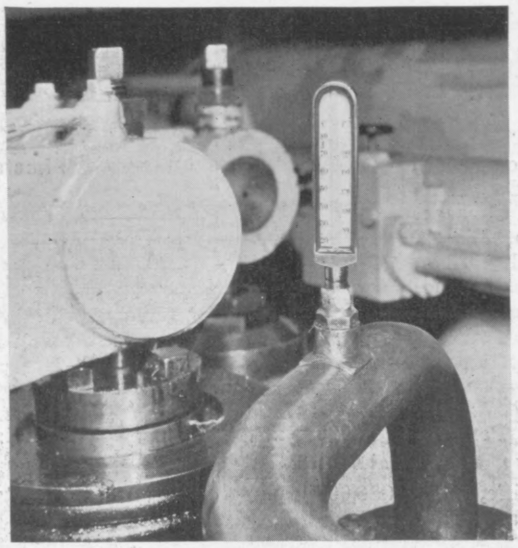
I asked another what he thought of thermoelectric pyrometers. "Well, I don't know whether you have got the same thing in mind that I have, but if you have I'm sold on them. Only, the fellow that came aboard to sell the equipment did not seem to understand just why we take indicator readings and tried to tell me that I could do without an indicator if we had his instruments installed. When he sprang that, I knew he did not know his stuff, and I'm off of him." That man wanted the instruments, but not the salesman. Another said the darned things would not fit his engine, he could not have the engine piping altered and the manufacturers would not make a departure from standard designs of thermocouples, so he guessed he would have to do without them.

Perhaps the men responsible for the installation of cheap thermometers, or too few thermometers, and those responsible for neglect or breakage of them without making repairs or replacements, do not know how great a chance they are taking of doing serious damage to the engines. Perhaps they hope that kind fate will intervene in their behalf and carry them through where no one else has ever been able to pass unscathed. Conjecture along these lines is, however, of less value than knowledge of the probable outcome of this sort of neglect.

Not all of our cracked cylinder heads, badly worn or scored cylinder liners, fractured pistons and stuck rings are chargeable to poor castings and improper lubrication. Many of them are directly traceable to a lack of knowledge of what the engine is doing.

To know what the engine is doing the engineer must keep close tabs on the various temperatures, and this applies with the greatest force to the main propelling units of motorships, for with these there are seldom the fractional load periods that occur in most stationary plants. The propeller is a full load for the engine, and as long as the ship is running at full speed the engine is working at full capacity. Only when an engine is working at part load can any great departure from the ideal condition of operation be continued for long, and that a departure may be made under such circumstances is only due to the fact that all stresses are lessened with lowered loads.

There are three common reasons for not getting exact temperature readings. One is poor thermometers or none at all. Another is inaccessible thermometers. Lastly, there are some indifferent engineers, and as to how to solve this last problem we will make no suggestion.



Temperature of water from cylinder head

In the long run one of the finest and cheapest solutions to the first two reasons lies in the installation of electrical distance thermometers now commonly employed ashore for indicating and recording temperatures from far below zero to about 1,000 deg. F.

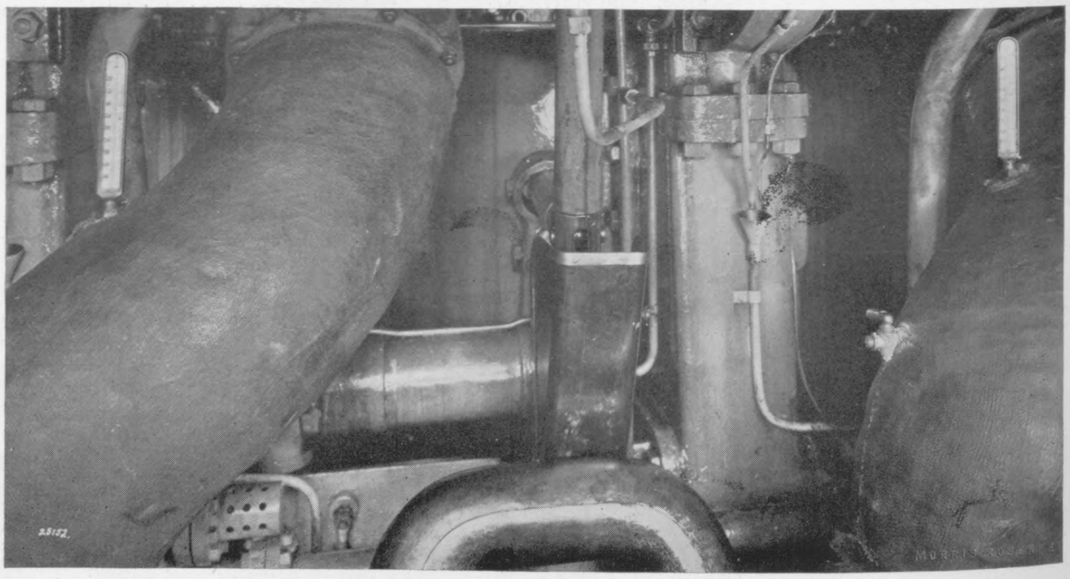
The temperature of exhaust gases generally receives less attention than that of the cooling water for cylinder and piston, yet it is equally important to successful operation. The capable engineer watches the exhaust with great care, because it gives a quicker, if less accurate, indication of what is going on within the cylinder than the engine indicator does. The indicator leaves little to be guessed at, whereas the exhaust gas temperature may leave one guessing. If a rise in temperature is noted, and it seems excessive, the indication is poor atomization and slow combustion, late fuel valve opening and afterburning, too much fuel and overload or too little lift of the fuel valve and slow or late combustion. The fuel valve lift may be checked, but not accurately with the engine in operation. However, such a check is sufficient to indicate whether the trouble lies in the quarter. If the fuel pumps have commenced to pump more fuel than usual it is quite safe to conclude that the measuring valvet tappet adjusting screw is loose. If neither of these conditions exists, then most likely the trouble is either dirt in the atomizers or enlarged orifices in the flame plates.

The thermometer does not indicate the exact nature of the trouble, but it does show at once the occurrence of trouble. It is no substitute for the engine indicator, but it often shows when the indicator should be used.

Conditions which bring about a rise in exhaust gas temperature generally also cause smoke, which is an indication of incomplete combustion, meaning unburnt residue of fuel oil—generally soot and carbon—within the cylinder mixing with the lubricant, causing pistons to drag, followed by frictional losses and sometimes gummed-up and sticking rings. These are the forerunners of heavy liner wear and sometimes of seizures, neither of which is pleasant to contemplate.

A subnormal exhaust gas temperature is not so serious. It generally means nothing more than a weak cylinder not getting enough fuel and in consequence inefficient. If the engine r.p.m. remain up to normal, or are held up to normal by more fuel, the other cylinders are doing their own work plus that of the weak cylinder—which is not so good.

So much for the exhaust gas temperatures. Now let us look into the temperatures of cylinder cooling water. We have been limited in the size of practical single-cylinder units by the difficulty of transmitting more than a certain quantity of heat to the cooling water without setting up severe stresses in the cylinder head and liner castings. We are close to that limit in our larger engines. Most ships'



Temperature of exhaust from the lower ends of a double-acting engine

main propelling units are large, and we are thus not permitted the greater range of cooling water temperatures that may exist with safety in smaller engines. I say safety and not efficiency. Thermal efficiency is another matter entirely.

If the cooling water temperature at the top of the cylinder head be too high, insufficient heat is being transmitted to the water to protect the cylinder lubricant. If the cooling water temperature run too low the great difference in temperature between the inner side of the casting exposed to combustion and the outer side exposed to cool water sets up a dangerous stress.

In large engines, where the safe cooling range is limited, inaccuracies of temperature readings are important. The fact that cooling water temperatures, unlike exhaust gas temperatures, are not too great to be felt with the hand leads to the bad practice of making a guess in that way. It is indeed a remarkable sense of touch that is accurate. Even a poor thermometer is better, and that is not good enough.

Neglect of these matters is not noticeable on the engine at once. A casting under severe stress does not pop open like a gourd bounced upon a boulder. The stresses work slowly, stretching and pulling the metal until the elastic limit is reached and surface cracks develop, which in turn grow and grow until the other side of the casting is reached and an opening thus made. Liner wear is similar. It does not happen instantaneously, but comes slowly, so slowly in fact that it causes too little worry. Sometimes two or three years elapse before much attention is paid to it, but when it has to be rectified then the rectification is no small matter. Everyone wants to know "how come."

The question of piston cooling is in a general way similar to that of cylinder cooling and cylinder head cooling, but since this is not an analysis of the various problems, great and small, connected with this subject, I will not dwell upon that. I refer to them to impress the importance of the various temperatures throughout the oil engine.

Granting they are very important, that in time past we have not been sufficiently careful, and that engines have suffered, what then, you may ask, is the trouble? The answer is—instruments.

I blame the instrument maker, the engine builder and the operator of large oil engines for existing conditions. They have failed to get together. We have suitable instruments, fine engines and capable operators, but never a first-class installation.

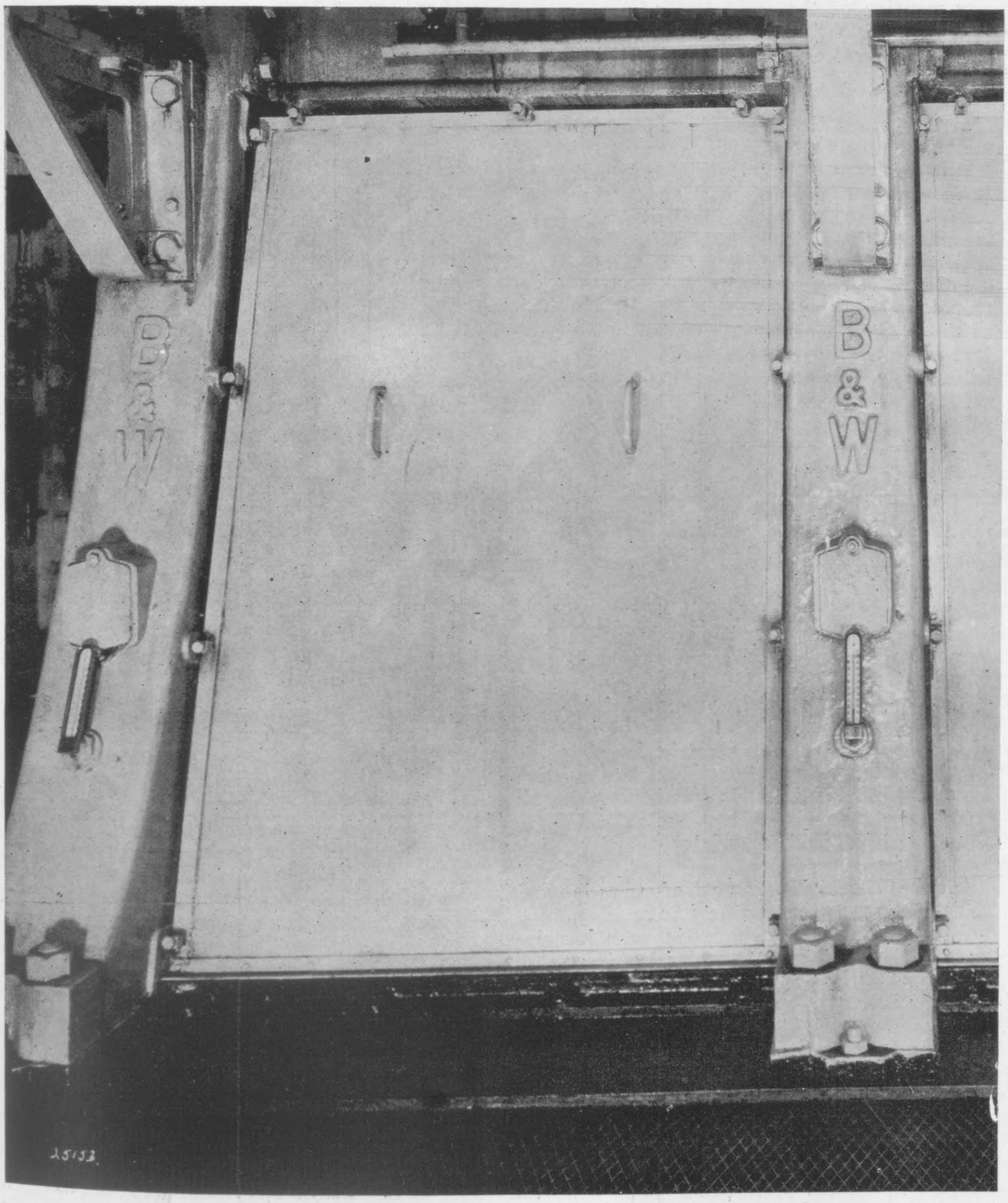
In reading a pamphlet of one of the most prominent manufacturers of electrical distance thermometers and thermo-electric pyrometers I find these instruments mentioned as suitable to almost every form of heat measurement, including marine steam work, and yet there is no mention of their adaptability to Diesels, although they are the most ideally adaptable to this work of any instruments of the sort in use today.

If instrument manufacturers will study the problem of applying their instruments to Diesels, and if engine builders will provide suitable openings for the thermo-couples, and if operators will demand that this be done, a great saving is bound to be effected in operation. I predict there will be a change. Thermo-electric pyrometers will become as much a part of all large Diesels as the fuel lines and lubricating system, and they will fit in just as nicely and look just as neat. Then we will see a nice little improvement.

The engineer is not going to have to run all over the engine room to know what his temperatures are. He will read them before him on the maneuvering platform. Every reading will be exact, because the instrument can be checked and adjusted to accuracy at any time. Maintenance expense of the instruments will be eliminated, because they are inherently sturdy and have no natural tendency to get out of order. For experimental work, recorders will come into use, and a chart will be made of every temperature variation at every minute of the run. It is even possible that thermostatic controls will be installed on the water system.

It is all here and ready for application. Just to get together and analyze the situation is all that is needed to prove beyond the question of doubt that the new method will be better for everyone concerned and that the engines to which it is applied will give better service than they do now while so much depends upon the personnel.

Instrument makers must also undertake proper educational publicity. Diesel engineers who have graduated from steam have seldom learned the value of thermometers and pyrometers in their steam experience. Ship owners or managers or superintending engineers have not been accustomed to get requisitions for such equipment for steamers. They have to be educated to the acceptance of the sound maxim that what is spent on such instruments is saved many times over from reduced repairs.



Gripsholm's most important thermometers, temperature tell-tales of the piston-cooling oil

Thermometers on Gripsholm

How valuable is the aid of good thermometers is well evidenced by the testimony of Mr. Thorell, chief engineer of the Swedish-American motorliner GRIPSHOLM, which calls regularly at New York. Her big double-acting engines are rated at 6750 s.hp. each, with six cylinders of 33 in. diameter and a piston stroke of 59 in. They are plentifully equipped with high grade thermometers, the most important group being the thermometers on the piston-cooling oil lines, followed in order of importance by the thermometers on the water discharges from the cylinder covers and those in the exhaust lines. The Chief states when he goes down into the engine room his first inspection is given to the readings on the thermometers that show the temperature of the cooling oil coming out of the pistons.

So useful are these thermometers that in the engines for the next Swedish-American liner a special housing for them will be cast on the engine frames, affording them full protection against possible injury. The thermometers on the exhaust lines are not so important, but they are very useful because any variation from a steady reading would notify the engineers that an indicator card should be taken to determine the cause of the variation.

As a point of fact, the GRIPSHOLM'S engines maintain a uniform excellent of operation. How far this may be attributed to the assistance afforded by intelligent use of good thermometers is speculative.

The heat measuring instruments, however, contribute materially to the ease of mind of the engineers because they afford a continual check. The thermometers on the GRIPSHOLM have metal protected bulbs and are inserted into metal wells, in the pipes.

Letters to the Editor

Why Not Diesel Engineers?

To the Editor of MOTORSHIP:

On the Pacific Coast the old argument of steam engineers versus gas skinners still continues unabated.

To go back a few years when motor ships started obviously there were no Diesel engineers. Men were recruited from three classes, gas skinners, shop men and steam engineers, each of whom had some qualifications for the job. The gas skinners were accustomed to operating internal combustion engines though of small size. Some of them may not have been high class mechanics, but with the aid of hay-wire and brown soap they usually kept the gas engines going. Most of these engines were operated from the pilot house. Where engineers were carried because of the gas it was customary to stand watch anywhere except in the engine room. However, these engines required little attention, for if anything went wrong they would slow down or stop with no injury to themselves.

The shop man had the mechanical training for the job and could make the required repairs, but lacking operating experience there were too often repairs to be made. Both the gas skinner and machinist were ignorant of engine room etiquette.

Few steam engineers came in until after the collapse of shipping, for while the boom was on there were plenty of better jobs available on the steamships. However, when they did consent to operate a Diesel engine it was usually with a vast amount of assurance. Were they not accustomed to operating large machinery and maintaining engine room discipline? They were. As far as ordinary operation is concerned a steam engine might be described as a collection of bearings surrounded by various unimportant parts. Doping hot bearings and passing them to the next watch had been developed into a fine art. Ergo a Diesel engine also consists of bearings. These bearings, however, are enclosed in a burglar-proof construction and cannot be doped, but with the present engines require little attention. This leaves nothing for the engineer to do except to plant some part of his anatomy in an engine room chair—until something happens.

The plain fact is that neither the gas skinner, shop man, or steam engine is inherently a Diesel engineer. All have had some useful training, but their education is not complete, neither is it completed by three months in a shop. The only place to learn the tricks of operation (there are some) is in the engine room.

Of the men who have entered the field of operation in the past some have dropped out, some are getting by, while others are really to be classed as Diesel engineers. This with little if any reference to what they had done previously, so why not forget their antecedents and rate them by their present ability. Also when new jobs come up many of which are little past the experimental stage why not give the responsible positions to those who have made good in the past at this work.

"OLD TIMER."

Fuel Oil Meters

To the Editor of MOTORSHIP.

In a recent issue you published an article which we have read with unusual interest, treating, as it does, of a situation with which we have long been familiar. The general trend of the paper is so timely and informative, and shows such a clear intention to cover the subject as fully as possible in a brief space, that we feel sure you will pardon us if we call your attention to what seems to us a serious omission, namely, failure to make any mention of the oscillating piston type of oil meter, which is also a positive displacement device, but entirely unlike the disk in its general design and in the operation of its measuring unit.

It is obvious that the value of any fuel oil meter depends (1) on its accuracy, (2) on the length of time it will retain that accuracy. It is in the successful meeting of these two requirements that the oscillating piston meter is unique. Practically all meters are built with the care and precision that you have indicated in your article. Many of them register very closely when first installed, and some of them for a considerable period afterwards. Naturally with wear comes a falling off in accuracy, and the questions then arise: can the meters be restored to their original efficiency? how easily? at what cost?

In our design the measuring chamber is a shallow cylinder, consisting simply of a ring and two plates. In it a similarly shaped (cylindrical) piston oscillates easily around a central post, completely emptying the chamber at each oscillation. Registration is accomplished by an intermediate gear train, the same as in the disk types. When wear occurs in the measuring unit of this type of meter it can only be in either of two directions; that is, in the height or in the diameter of the piston, and can be corrected with the greatest ease. The first adjustment is made by grinding down the ring of the cylinder a trifle, the second by substituting a slightly larger central post or roller. With these easily performed and inexpensive attentions the meter can be brought right up to its original high accuracy and kept there indefinitely. This property, so vital to efficient and economical operation, will be found only in this type of oil meter.

If we speak rather positively on this subject it is because we feel that we have earned the right to do so, since we have been meter makers for over 56 years and are thoroughly familiar with the design and performance of all types. Our recomendations of the oscillating piston meter are made with a full knowledge of the results that can be obtained in actual oil-measuring service. We can also speak quite without prejudice, as we have made disk meters ourselves ever since 1888—in fact, were the first concern in this country to apply for a patent for a disk meter.

In closing, please accept our compliments on the care and research displayed in preparation of your very interesting article. The topic is one of undeniably great interest and importance to marine circles in general, and motorship engineers in particular. Your paper is doing a valuable service in spreading dependable information on the subject.

Very truly yours,
NATIONAL METER COMPANY
GEORGE D. MACVEAGH,
Oil Meter Dept.

Making the "Chick" Pull

Hank, the skipper of the motor tug Chickamauga was sitting in the galley one evening talking with a new engineer, who had just joined. The subject was the "Chief" who had quit.

"Do you know," said Hank, "what that damned Dutchman would do? Well, I'll tell you. Whenever I was pullin' around a point with a head tide and tryin' to make the eddy on the other side, with about 20 sections of logs, he would slow the engine down."

"He would?"

"Yep! Now if he had picked her up about five turns, why we would 'a'got around all right."

"Didn't you?"

"Oh, sometimes we made it an' then agin we didn't."

"How do you know he slowed her down, Skipper?" the chief asked.

"Well in the first place he was always runnin' her slow, an' anyhow I used to stand in the engine room door an' watch that little dingus that tells how fast the engine turns."

That evening when the new "Chief" went on watch he looked the tachometer drive over very carefully. The next time the engine was stopped he wound some tape around the driving pulley. It was belt driven.

Thereafter the apparent r.p.m. were 205 in place of 195, and this chief made a friend of the skipper at once. The friendship lasted as long as they sailed together.

Hank used to sit in the mess room and say, "Boy, you sure can make this old hoss pull. She whips a 20-section tow around Sand Point against a head tide without no trouble at all."

The "Chief" would make a polite rejoinder and let it go at that, and unless Hank reads this he will never know what made the "Chick" pull so well.

A. B. N.

Messroom Maxims and Fables

BY looking for trouble it may not only be located, but forestalled.

Checking up roller clearances, steaming out air receivers and chasing air leaks not only helps to provide exercise but keeps the job in better shape. Now we suppose there exists at least one engineer who feels that he could gain more exercise by administering a kick. Laugh it off!

We do not advocate the use of profanity, but we simply can't stand the "Goodness Gracious" type of engineer.

Friction of liquids in pipes increases as the square of the velocity. Oh yes! but what about pre-Volstead liquids around the windpipe? We can't laugh that off.

The quick thinker should think twice before he acts. The slow thinker should ask some one else who can think twice and act while he is making up his mind to think.

Most engineers prefer the smooth running job as it is found at sea to the muddled up condition of an engine room while repairs are being made.

The more work we do the less we have to do and the less we do the more we have to do, and that's no baloney.

One pound of salammoniac, two pounds of flour of sulphur and eight pounds of iron borings mixed to a paste with water makes a good rust joint.

It takes a clever man to be a good liar.

It does not take a big man to think in terms of nothing greater than what he is doing.

It is a bad policy to blow all of the starting air away because the fuel valve is not primed.

To hear some men talk one might think the ship came to port especially to give them shore leave.

Putting a guard over a set of gears is much easier than putting on a new finger.

It looks like hell to have tin cans hanging around the engine room under leaking pipes, but it looks much worse to have these always running over.

When Henry Ford perfects his flying flivvers we propose to go to sea again and while off watch we will go home.

Some men are careful and some are careless, while others are too dumb to be either.

Quite true: The drawers under your bunk are not intended for store rooms.

The right time to have the men wipe the cams and rockers is when the engine is stopped.

Sketches and Working of Oil Engines*

Fuel Injection as the Distinguishing Characteristic: Effect on Economic Status and Technical Characteristics

WORKING as it does according to the general scheme of internal combustion, the oil engine may very naturally be expected to possess many of the features common to all internal combustion motors. Interest centers, however, about those properties of the oil engine which render it different from all other machines of the internal combustion class and which therefore make its separate classification necessary and useful.

Among the characteristics common to oil engines and the other members of the internal-combustion family are the manner of supplying the cylinders with the air needed for combustion, exhausting spent gases, and the use of compression as a means of obtaining heat independently of the fuel. Whether the cylinders are filled at every alternate revolution through specially operated poppet valves or at every bottom dead-center through ports cast in the cylinder walls has no primary significance and a review of these well-known processes would uncover no peg on which to hang a workable oil engine definition.

Owing to the wide variety of engines burning petroleum or its multifarious derivatives, the fuel used also fails to yield the most satisfactory means of picking out the oil engine from the assemblage of internal combustion motors. Gasoline, from the chemical point of view, is perhaps as much of an oil as the residues with which dusty roads are coated. If used as a basis of classification, gasoline might warrant the statement that Ford automobiles are propelled by oil engines. The fuel oil generally consumed by real oil engines differs from gasoline mainly in the complexity of its constituents and in such secondary characteristics as volatility and viscosity. As a matter of fact, it might be possible to set up a row of variously-operated engines to consume each of the members of the hydro-carbon series from bunker oil to high-test gasoline. If the investigator were to begin at the engine capable of burning the heaviest of them and to pass on the others in the order of the volatility of their fuels, he might find it difficult to name the last machine requiring the classification "oil engine" and the first one to be designated "gasoline motor." A less fantastic way of giving the oil engine its pedigree appears to be feasible.

The injection of fuel into the working cylinders of oil engines distinguishes them sharply from all other internal combustion motors, and it seems immaterial from this point of view whether the spray is produced by compressed air or hydraulic means. Injection occurs substantially at the end of the compression stroke and rules out from the oil engine classification all machines in which fuel enters the cylinder concurrently with the air charge. It would seem as though the injection feature is therefore sufficient in itself as a basis for classifying oil engines and for distinguishing thm in a useful manner from gas, gasoline or kerosene engines.

Charging the cylinder solely with pure air and injecting fuel only towards the end of the compression stroke has far-reaching consequences on the technical and commercial character of the oil engine. It renders possible the use of compression-heat alone to produce ignition and allows electrical or other specific inflammation devices to be dispensed with. It permits of a compression pressure yielding a higher over-all efficiency than that obtained in any other internal combustion engine and does away with the restriction of using only the more expensive low-boiling-point refined fuels.

Although it impresses the student of oil engines most strongly, the spontaneous ignition feature is perhaps the least fundamental of all. Millions of automobile engines now in service do not seem to be appreciably handicapped by their ignition systems and would probably not be revolutionized by the elimination of their spark plugs.

Gas or gasoline engines in which an air-fuel mixture is compressed below the self-ignition point and fired near the dead-center by the spark are limited as to thermal efficiency. When the compression pressure of such machines reaches the point where pre-ignition or "knocking" can take place, no further raising of the compression may be undertaken. Engines in which air only is compressed may be set to run at almost any compression. Too low a value is avoided in order to eliminate the need for special ignition devices while the upper limit to which compression may be carried in injection machines is marked by a falling off in the mechanical efficiency. Once a pressure has been reached at which the compression heat will always safely ignite the fuel as it is injected, further increase of compression adds rapidly to the friction of the mechanism and begins to neutralize the gain due to the improving thermal utilization of the fuel. It so happens that the best combination of thermal and mechanical efficiency is attained at a higher compression pressure than that necessary for automatic ignition. Needless to say, this pressure is many times as great as that set for mixture-compressing machines by the pre-ignition barrier.

Fuel injection, as distinguished from fuel-carburetting, puts oil engines on an entirely different part of the economic map from that on which the usual run of internal combustion motors is found. Fuel injection is preceded by the establishment of an intensely high temperature due to compression alone. It takes place after the oxygen molecules have been concentrated far beyond the density which they attain in gasoline engines which are limited by the pre-ignition danger to low compressions. Combustion is therefore made far more independent of the chemical and physical properties of the fuel while the characteristic gas-engine requirement of forming an "explosive mixture" is abolished altogether. As a result, the range of available fuels is widened to an unprecedented degree and the cheapest ones become included in the list. Fuel injection therefore permits much of the compactness, cleanliness, and many other characteristic internal combustion advantages to be realized on an enormously greater scale than would be possible without it. Fuel injection is the trade-mark of the oil engine.

Fig. 1 shows in a general way how the injection principle permitted the oil engine to evolve out of the mixture-compressing internal motor along the higher-compression route. All the quantities by means of which internal-combustion engines may be judged—pressures, temperatures, and efficiencies—can be readily arrived at with the compression ratio as a basis. This has therefore been chosen for the horizontal scale according to the method of Dr. Hugo Guldner.*

As the clearance space of an internal combustion engine is progressively decreased, the final pressure and temperature at the end of compression along with the therman efficiency mount up as shown by the curves. Thermal efficiency is defined as the ratio of heat energy contained in the fuel to the heat converted into mechanical work on the piston, the latter being directly measurable by means of the indicator card. If thermal efficiency is denoted by the symbol E_t, then

$$E_t = \frac{\textit{Indicated foot-pounds per unit of time}}{778 \times \textit{B. T. U. supplied per unit of time}} = \frac{W_i}{W_h}$$

778 being the number of foot-pounds equivalent to one British Thermal Unit. The number of heat units supplied to an engine per unit of time may be readily arrived at by multiplying the number of pounds of fuel consumed per hour by its heating value.

Although thermal efficiency gives a correct idea as to the engine's performance in the matter of converting fuel-heat into mechanical work made available on the piston, it does not tell the whole story as to the engine's ability to convert fuel-heat into mechanical work available at the coupling of the crankshaft. The latter is generally measured by a brake or other form of absorption dynamometer and when compared with the indicated work of the engine reveals its mechanical efficiency, E_m.

$$E_m = \frac{\textit{Brake foot-pounds per unit of time}}{\textit{Indicated foot-pounds per unit of time}} = \frac{W_b}{W_i}$$

As a final estimate of the engine's performance, however, it is necessary to know what fraction of the fuel heat is made available at the crankshaft coupling; this is called the overall efficiency and is denoted here by the symbol E_o.

$$E_o = \frac{\textit{Brake foot-pounds per unit of time}}{778 \times \textit{B. T. U. supp. per unit of time}} = \frac{W_b}{W_h}$$

As different engines have varying thermal and mechanical efficiencies, their overall efficiencies are also different. As will be apparent shortly, the inter-relation of thermal and mechanical efficiencies found in various types of engines affords a useful method of classifying and comparing them with one another.

Multiplying equals by equals gives equals, hence

$$E_t = \frac{W_i}{W_h}$$

$$E_t \times E_m = \frac{W_i}{W_h} \times \frac{W_b}{W_i} = \frac{W_b}{W_h} = E_o$$

$$E_m = \frac{W_b}{W_i}$$

This is the relationship between the three efficiency curves drawn in Fig. 2. Direct reasoning would also have shown that the values of the overall-efficiency curve would be obtainable by multiplying together those for mechanical and thermal efficiencies.

Thermal efficiency could be increased indefinitely by raising the compression ratio, fundamentally because of the temperature rise which accompanies it. Formulas for this purpose may be found in almost any standard text-book on thermodynamics. However, the gain due to raising the compression becomes progressively less as the higher compressions are reached, a fact plainly illustrated by the thermal efficiency curve.

Mechanical efficiency, on the other hand, falls off as the compression is raised, for the obvious reason that higher pressures cause

---

* Summary of a course of instruction at the Polytechnic Institute, Brooklyn, N. Y., by Julius Kuttner, B. Sc., Licensed Chief Engineer, Associate Editor of Motorship. This is the First Chapter, being a revision of the introductory notes published in the January, 1925, issue.

*Entwerfen und Berechnen der Verbrennungskraftmaschinen, page 18.

more friction on the moving parts of the engine. Just as the thermal efficiency curve rises sharply at low compressions, so the mechanical efficiency curve begins to fall off abruptly as the higher pressures are reached.

The overall efficiency, being the product of the two just considered, therefore has a maximum value somewhere between the extremes of high and low compressions, this being the point *A* corresponding to a compression ratio of about 10.4 and a pressure of 310 lb. per sq. in. Lower compressions than this give lower overall efficiencies because of the droop in the thermal efficiency curve; higher compressions do the same because of the falling-off in the mechanical efficiency curve. In other words, increases in compression beyond the point *A* are accompanied by losses in mechanical efficiency which are more than offset by the slow gain in thermal efficiency. It is to be noted, however, that the curve for overall efficiency is quite flat in the region of the point *A* and therefore permits of wide variations in the compression without producing serious practical effects on the overall economy of the engine.

A study of the temperature curve graphically illustrates what has previously been said about mixture-compressing gas engines being limited to low efficiencies by the pre-ignition barrier. Already at a compression ratio of about 4.5, temperatures around 500 deg. Fahr. are obtained; they impose limitations as to the kind and richness of the gas mixtures which may be used and provide a good living for quacks selling "anti-knock dope" for gasoline engines. The mechanical efficiency in the neighborhood of these low compressions is of course high, ranging well above 90 per cent; but when multiplied by the corresponding thermal efficiency the best result obtainable is the 30 per cent indicated by the point *B*. This is considerably lower than the optimum obtainable with oil injection engines as indicated by the point *A*.

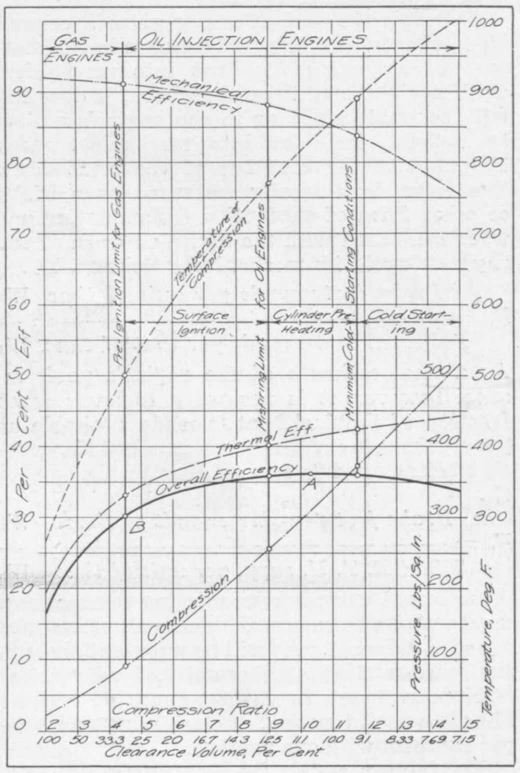


Fig. 1. Compression and efficiency chart

With the adoption of the fuel injection principle, compression ranges higher than those indicated by *B* are opened up. As higher compressions are used considerably greater values of overall efficiency are obtained, while temperatures are approached which make spontaneous ignition of the injected fuel certain under the normal, warmed-up running condition of the engine. For practical purposes too much emphasis should not be laid on the values calculated for the temperature curve according to the well-known relation

$$T = (t + 460) \times (\text{comp. ratio})^{1.35} - 460$$

where T is the final temperature of compression and t that of the air drawn into the cylinder. Among the factors which make it uncertain are the indefinite heating suffered by the air in passing over heated engine parts such as cylinder walls, valve heads, and pistons. Conditions of water cooling and the shape of the combustion space also have their influences. Some authorities claim that the air is trapped in the cylinder of a properly warmed-up engine at temperatures not less than 110 deg., even with engine-room temperatures nearing freezing point. On the other hand, when the engine is started up from cold, it may well happen that compression begins at 60 deg. or less. Not much figuring is needed to show that widely different values for the final temperature T will be obtained according to which of the two figures is substituted in the formula for the value of the initial temperature t. According to the curve as drawn, compression ratios of 6 or 7, associated with pressures around 140-175 lb., would be ample to produce temperatures for firing ordinary 250 deg. flame-point fuel oil. As a matter of fact, G. J. Lugt and Harry Hunter* claim to have successfully operated an injection-ignition engine with only 125 lb. compression. They state that this is perfectly feasible so long as the cylinder is brought up to a normal working temperature before the injection of fuel is begun. The method is used on the Werkspoor double-acting 4-cycle engine, hot exhaust gases from the top ends operating on high-compression being circulated through the 250 lb. compression lower ends prior to operating the latter on fuel.

What has been said thus far applies strictly to engines having completely water-cooled cylinder walls and heads and therefore not primarily dependent upon the transfer of heat from metal surfaces to the air being compressed. It would be folly, of course, to assume that such an interchange of heat does not take place and the values of the curve in Fig. 2 are calculated from indicator card compression lines as they occur in water-jacketed cylinders operating at normal working temperatures. The largest amount of heat is probably absorbed by the air when it is still relatively cool at the beginning of the compression stroke. Towards the end of compression, its temperature is higher than that of the confining water-cooled metal surfaces and therefore causes a loss of heat from the air to the metal. At the same time it must be borne in mind that the air is not moving very actively while being compressed and that the layers nearest the metal are apt to have temperatures quite different from those found at the center of the air body. The values in the curve are intended simply to give the most commonly accepted averages.

When engines were first built to consume relatively dense, non-volatile fuels, it is probable that higher compressions were used merely for the sake of improving combustion, rather than for the express purpose of obtaining better efficiency or even spontaneous ignition. The early low-compression machines were therefore fitted with incandescent surfaces or hot-heads initially warmed by means of blow torches and subsequently maintained at a red heat by the fact that they were deprived of the water-cooling provided for the rest of the cylinder. Some of these engines depended for ignition upon the direct impingement of the fuel upon the incandescent surfaces; in others, however, air-heat, augmented by contact of the air with the hot surface, must have been the determining factor because the spray of fuel was directed in such a way as to prevent any "droplets" from directly striking the hot surfaces. In principle, at least such machines are practically equivalent to high-compression full-water-jacketed engines; so long as heated air alone ignites the fuel, it seems relatively unimportant whether the final temperature is produced chiefly by compression or by the combination of compression and contact of the air with a hot surface.

* 65th Session of the Institution of Naval Architects, June 27, 1924, (England).

Surface-ignition engines, however, differ from high compression machines when the fuel is injected against the hot surface far in advance of the dead center and when an air-fuel mixture is formed by the liquid fuel boiling away from the incandescent metal. When that occurs the machine may more properly be regarded as belonging to the gas engine class, even though it may operate at compressions giving a slightly higher efficiency than the latter. As the timing of ignition is substantially unrelated to the time of injection—depending upon the rather vague and undefined point at which the increasing temperature of compression causes an explosion—an operating condition which may be unsatisfactory is produced. Such machines may fire much too soon or much too late and are sometimes incompletely corrected in this regard by the varying use of a water drip.

It may therefore be accepted as one of the trade-marks of an oil engine that ignition must follow injection quickly enough to permit of varying the timing by changing the time of injection. If this condition is to be realized the compression must be fairly high and the use of a hot surface as a contact-inflammation device is ruled out.

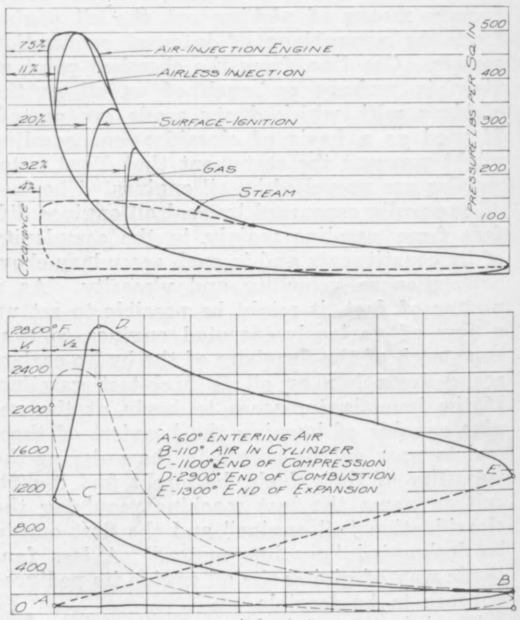


Fig. 2. Temperature and pressure cards

One of Dr. Diesel's strongest claims to being the inventor of the modern oil engine probably lies in his insistence on high-compression as a means to efficiency first and to spontaneous ignition afterwards. This combination, at any rate, appears to define the oil engine in the most unequivocal way.

As far as the attainment of maximum efficiency is concerned, engines operating at compressions lying between 260 lb. and 360 lb. per sq. in. would come nearest to meeting Dr. Diesel's specifications. The machines in this range, however, would not fully meet the automatic ignition requirement. They cannot be started without the application of heat from an exterior source to the cylinders. In the Doxford opposed-piston oil engine this is done by admitting steam to the jacket circulating system and in the lower ends of the Werkspoor double-acting engine, as already stated, hot exhaust gases from the top ends fulfill the same purpose. Both types of engines are fully water-jacketed. Hot-bulb engines equipped, with heating torches are rarely used in this range of compression, probably because the heated surface is not entirely proof against

the large forces. All of them, however, require some form of preparation in the way of heating before they are ready to start and to that extent they sacrifice one of the cardinal internal combustion engine advantages—instantaneous starting from cold. Below the 260 lb. compression limit engines of the prewarming type cannot be altogether safely depended upon for regular firing at zero and fractional loads; when fitted with hot surfaces it is not uncommon to find them dependent upon the assistance of the blow-torch whenever any considerable amount of idle or light running is to be done.

It is generally believed that engines with a minimum of 360 lbs. compression will always safely fire when idling or when being started cold. The theoretical temperature associated with this pressure is about 890 deg.—apparently a safe margin over the highest flamepoints found in the heaviest fuels. It is to be recalled, however, that the piston rings of a cold engine are not as free in their grooves as they are when operating normally and that the 360 lb. compression pressure is probably not attained during the first few minutes after starting. As the engine parts wear and begin to require overhaul, further decreases in the cold compression pressure and temperature are likely to occur. Operators sometimes make good such deficiencies by unbolting the inlet air elbow of the engine before attempting a start and by allowing the flame from an ordinary plumbers' torch to be sucked into the valve passage. On the whole, 360 lb. compression seems to be the minimum which guarantees against an excessive amount of messing about while getting the engine under way. It lies somewhat beyond the point of maximum efficiency *A*, but hardly more than would cause a one per cent falling-off. Safe starting under all conditions and the avoidance of misfires while idling are far more important matters.

There are two additional classes of oil engines in which compressions higher than 360 lb. are used, one of them being characterized by the use of a pre-combustion chamber and the other by compressed-air injection. When airless-injection is used, lower hydraulic pressures may be employed for spraying, if the fuel first enters a small auxiliary space. The latter generally comprises a fraction of the clearance volume and is connected to the main cylinder space by some kind of a constricted neck or throat. It permits the air needed for combustion to be concentrated in a shape capable of being conveniently supplied with fuel and the spray of oil is more readily protected against impingement on the piston. Containing only a part of the air needed for combustion, it permits the fuel to burn but imperfectly while the piston is at the top dead center and therefore offers a ready means for curbing excessive pressure rises. Complete combustion, accompanied by turbulence and active mixing, are obtained as the piston recedes on the outward stroke and allows the contents of the pre-combustion chamber to expand into the cylinder proper. Such machines require compressions around 500 lb. per sq. in. because the pre-combustion chamber, being water-jacketed, offers a large surface to cool the air charge. It is probable that this effect, coupled with the restriction in the supply of oxygen, accounts for the need of a higher compression than that found in airless-injection machines with plain-shaped combustion spaces.

Air-injection Diesel engines require a compression of 475 lb. per sq. in. in order that the refrigerating effect of the injection air may be safely neutralized at starting.

Although oil engines are thus seen to differ widely among themselves with respect to the pressure and temperature at which fuel is injected, it is a curious fact that the maximum pressure reached in the cylinder as the result of combustion is not much different for the various types. The higher the pressure established by compression alone, the less is the increase which occurs when the fuel begins to burn. The lower the compression, the earlier the fuel is injected in advance of the dead center and the more time is available for building up combustion pressure while the piston is substantially at rest near the inner dead center.

Gas and gasoline engines are frequently called "constant-volume" engines because ignition takes place while the piston has practically zero motion and while little is added to or subtracted from the clearance volume in which the combustion is taking place. As the gas and air are well mixed, propagation of the flame throughout the charge is rapid, consuming so little time that very few degrees of crank motion are taken up by it. It is to be remembered, of course, that flame propagation throughout a gas engine mixture proceeds exactly as fire spreads through a burning house; hence the term "explosion" tends to give an incorrect picture of the process. As the compression temperature of a gas engine is insufficient to produce combustion, the heat necessary for the chemical reaction can be supplied only by a spark or equivalent device and subsequently by the heat from the burning portions of the mixture. They heat up the portions next to them until the latter burn. These, in turn, heat and ignite still more remote layers until the entire charge is consumed.

Note that this is a progressive, step-by-step process whose intrinsic smoothness belies the shocks it is reputed to produce. Gas engines generally knock only when there is something mechanically wrong with them, or when pre-ignition conditions replace the step-by step combustion with detonation. Too high a compression in a gas engine affects all the parts of the mixture at once and makes them all attain ignition temperature at the same time. Then a real combustion shock is produced, but not when normal ignition by spark is taking place.

Owing to the chemical constitution of the heavy fuels used in oil engines, place-to-place flame propagation throughout the sprayed-in charge of oil does not play as great a part as it does in gas engines; at any rate it is not probable that this phase of combustion can proceed at the same high speed. However, since compression-heat causes ignition, and since it heats practically all the minute oil droplets alike, the tendency for a sprayed charge of oil to "go off" in all places at once is greater. It takes a longer time for the heat of compression to change the state of the entire charge in such a way that heat-liberating oxidation can begin, on the other hand a certain amount of simultaneous ignition is bound to occur at various points of an oil engine charge. This phenomenon is known as detonation and its extent varies with the type of oil engine and its fuel spraying system.

No matter in how fine a state the oil spray reaches the hot compressed air charge, a certain amount of time must elapse even before the most minute oil particles can be vaporized, mixed with oxygen, and ignited. In the meantime the spraying device continues to feed in oil so that a certain accumulation of combustible matter must take place before the first flicker of flame appears. As this occurs in several places at once, detonation or shock-like combustion is frequently met with in oil engines.

Although tending to make the operation of oil engines a trifle less smooth than that of gas engines the slight combustion shocks are of little practical consequence so long as the mechanism of the engine is sound. Shaking up the mixture is beneficial in producing better and cleaner combustion.

As measured on the indicator card, the maximum pressures of self-igniting oil engines are curiously alike and do not vary much above or below 500 lb. per sq. in. That applies about equally well to machines with a 310-lb. compression as it does to engines compressing up to 500 lb. Whereas the low-compression motors are set to operate with a considerable advance in the timing of injection, high-compression engines are so adjusted that the combustion of fuel produces a negligible rise in pressure and confines itself to keeping up the pressure as the recession of the piston causes the combustion volume to increase.

It is this uniformity of their maximum pressure that gives oil engines of the compression-ignition type their characteristic stamp. At the same time the presence of a certain amount of shock not measurable on the indicator card is taken account of by modern designers in their choice of main bearing and connecting-rod fastenings which are proof against battering loose. Only those engines working with pronounced low compression and with surface-ignition may be lightly built to less exacting standards.

In Fig. 2 are shown average indicator cards of steam, gas, surface-ignition oil engines and self-igniting oil engines of the high-compression type as a basis for comparison. They are not intended to serve as a basis for a formal classification system and call for little comment other than to point out the marked difference in engine practice which has resulted from the introduction of oil engines and their progressive modification in the direction of a 500-lb. maximum pressure. Not only the stationary, but also the moving parts of these mechanisms are subjected to heavier loads than those heretofore commonly met with in the older forms of prime movers.

In spite of the greater stresses which are met with actual breakages of oil engine parts are no more common than with other machinery. On the other hand problems of a subtler nature have been produced and the successful solution of the latter is signalized by the staggering increases which have recently occurred in the oil engine industry. Possibly the most important of the mechanical puzzles which have arisen out of the large forces occurring in oil engines is the occurrence of deflections and elastic deformations rather than direct failures. Bearings perfectly alined in an engine at rest have been found to give all the symptoms of misalinement during operation. The obvious solution for these early troubles has been found in locating metal sections and engine members in such a way that they offer a high resistance to deflections. Many examples of this are discernible in current practice and form an important part of the material treated in this course of study.

Another one of the characteristic oil engine problems which have been found capable of being solved, at least in cylinder sizes such as are currently met with, is that arising out of the high temperatures which are produced. Fig. 2 shows a "temperature indicator diagram" based partly on observations and partly on calculation. The captions on the figure make it largely self-explanatory. As a maximum temperature 2900 deg. Fahr. is indicated, a temperature which is calculated from the condition that the pressure in the cylinder is maintained constant up to the point of cut-off. Since under that condition the absolute temperature is directly proportional to the volumes of the gases $\frac{V_1 + V_2}{V_1}$ it is not difficult to see that some such temperature as 2900 deg. might be necessary to hold the pressure up. The volume V_2 is generally about 1/11 of the stroke for full load.

But 2900 deg. is above the melting point of iron, not to mention the decomposition point of lubricating oil. It is therefore not unreasonable to assume that this temperature is actually established only at the central core of the combustion space and that the outlying air volumes are not nearly so highly heated. At

(*Continued on page* 620)

Review of Recent Publications

The Directory of Shipowners, Shipbuilders and Marine Engineers

Compiled under the direction of the Editor of Shipbuilding and Shipping Record, London, England. 8½ in. x 5¼ in. 788 pp. Price 20 shillings net.

This is one of the most useful annual works of reference on international shipping that we have yet come across. It lists in alphabetical order the majority of the world's important shipowning firms, giving their addresses, the names of the principal officials of the company, and a list of vessels in the respective fleets with tonnages, bale and grain capacities, speed, draft, and where necessary, number of passengers carried. Similarly the world's principal shipbuilders, ship repairers and drydock owners are dealt with and particulars of their building berth capacity, etc., mentioned. Additional matter includes lists of consulting marine engineers, naval architects, and societies, associations and federations connected with shipping and shipbuilding. The book is fully indexed and forms a very compact and useful desk or traveling companion.

Fireman's Fund Register, 1926

By the Fireman's Fund Insurance Company. 9 in by 6 in. 211 pp. Published by the Fireman's Fund Insurance Co., San Francisco, Cal.

This annual publication containing a full register of all vessels owned on the Pacific Coast, their dimensions, tonnage, managing owners and home ports contains also much information useful to operators of vessels in Pacific waters. Pilotage and towage rates for the principal Pacific harbors, distances saved by traversing the Panama Canal, Pacific Coast weather, instructions for obtaining help from the Coast Guard, etc., are other matters dealt with in the text of this useful annual.

Inside Route Pilot—Key West to the Rio Grande

Issued by the U. S. Coast and Geodetic Survey, Washington. 5⅞ in. by 9¼ in. 144 pp. Price 50 cents. Published by Superintendent of Documents, Government Printing Office, Washington, D. C.

A new pilot volume issued by the U. S. Coast and Geodetic Survey specially to meet the needs of yachtsmen, it gives descriptions and directions for all the inland waterways and partially protected routes available for boats of moderate draft along the Gulf Coast. The book is not to be regarded as a complete coast pilot for this section of the coast, because little attention has been given to open waters where alternative inside routes are available. The volume is accompanied by a complete set of route charts.

United States Coast Pilot—Gulf Coast

Issued by the U. S. Coast and Geodetic Survey, Washington. 6 in. by 9¼ in. 244 pp. Price 75 cents. Published by Superintendent of Documents, Government Printing Office, Washington, D. C.

This "Pilot" deals with the Gulf Coast between Key West and the Rio Grande and replaces a similar volume published in 1916 as Section E of the Atlantic Coast series. The new book contains a large amount of information resulting from new surveys and from the important commercial development of the Gulf Ports during recent years. It has been rearranged, to present this information in a manner more convenient for use by the mariner, and is intended as a companion volume to the Inside Route Pilot.

Catalogs Received

Announcing a New Electric Cargo Winch—A 4-page folder giving the advantages of a new type single geared cargo winch operated by a General Electric Type C O M motor with solenoid brake and magnetic control. The General Electric Company, Schenectady, N. Y.

The Foos Type "L" Diesel Engine—Bulletin No. 707. A 4-page folder covering the Foos Type "L" Diesel illustrated by half tone cuts and a sectional drawing.

Naco Anchor Chain Cable—19 pages. Discusses the production of Naco Steel chain, lists tests to which it is subjected, and summarizes its characteristics. The National Malleable Castings Co., Cleveland, Ohio.

Fuel on hand, plus fuel received, minus fuel consumed equals fuel remaining aboard, but when tank soundings must be taken with the shop rolling how can we tell how much has been consumed unless meters are used?

The difference between using water and glycerine in the sight glasses of the lubricators is that glycerine shows a smaller drop of oil on the wire.

No use to swear at the generator because you shut down without pulling the switches and let the radio battery reverse the polarity of the fields.

It is a good plan when the hand on the voltmeter reads backwards to shut down, lift the brushes and throw the "juice" from another machine thru the fields.

A bunch of old rags lying in one corner of the paint locker may bring about spontaneous combustion.

The man who persists in feeling and acting "red" never seems to learn that the boss is generally his best friend.

Personal

Francis Hodgkinson has been appointed consulting mechanical engineer to the Westinghouse Electric & Manufacturing Company. Mr. Hodgkinson, who was for many years chief engineer of the Company's South Philadelphia Works and who, slightly more than a year ago was awarded the Elliot Cresson Gold Medal by the Franklin Institute, was educated at the Royal Naval School, New Cross London, England. Later he was associated with Sir Charles Parsons, of steam turbine fame, upon whose recommendation he became associated with the Westinghouse Machine Company which subsequently became the turbine building section of the Westinghouse Electric & Manufacturing Company.

A. D. Hunt follows Francis Hodgkinson as chief engineer of the South Philadelphia Works, with the title Manager of Engineering, the title Chief Engineer having been discontinued with Mr. Hodgkinson's new appointment. Mr. Hunt is a graduate of Cornell University. He was appointed to the South Philadelphia Works in September, 1919, in the Marine Service Station.

Louis R. Ford has been appointed Associate in Mechanical Engineering by the Trustees of Columbia University and will take up his duties in this connection on July 1. The work will be carried out in addition to his present consulting practice and his position as Diesel Engineering Consultant for the Morse Dry Dock and Repair Co.

L. J. LeMesurier, for the past 5 years marine engine specialist in Great Britain for Sulzer Bros., has joined the technical staff of the Anglo-Persian Oil Company. Mr. LeMesurier is recognized as one of the leading authorities on marine Diesel work. He held the rank of Engineer Lieut.-Commander in the British Navy from which he retired in 1913.

Sketches and Workings of Oil Engines

(*Continued from page 619*)

all events the duration of the high-temperature period is only a few thousandths of a second. The iron of oil engines does not, as a matter of fact, melt. Cylinder walls and pistons of such machines which have been running for years on end show signs of being well lubricated, although lubricating oil with a flash-point not much above 400 deg. Fahr. was used.

In conclusion it may be well to point out that there is plenty of mechanical apparatus working at temperatures higher than those which are averaged in internal combustion engines using heavy oil as fuel. Boiler flues and heat-treating furnaces attain higher actual metal temperatures than those commonly met with in oil engine practice. There is also a large class of machines such as hydraulic presses which handle larger forces. It is the combination of heavy loads with high temperatures that has made up one of the central problems of oil engine design and operation. How it has been overcome and a machine possessing notable qualities produced is the story which is being told here. The point of the story is the fuel injection system and the profound influence which it has had on the working, structure, and economic significance of the internal combustion engines to which it is applied.